THE

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ELECTRICAL v. MANUAL COAL-CUTTING.

THE strikes which have now been going on for some time in various parts of the country amongst the English and Welsh miners; the calling out of the military and police, the Metropolis itself being compelled to furnish a contingent of stalwart guardians of the peace to check the disgraceful scenes of savage rioting and bloodshed, without which "strikers" seem incapable of acting their part in these ever-recurring "comedies of errors;" the foolish and reckless destruction of valuable property and the starvation of thousands of poor women and helpless children, are all so well known to our readers, that it is not necessary to dilate upon a theme which only tends to show that our boasted civilisation is more apparent than real.

The work of the miner in the bowels of the earth is certainly not of the kind one would voluntarily select in preference to any other, but his hours of labour, hard though it be, are not long, and his wage is comparatively high. We are well acquainted with the dangers attached to his occupation, but we do not think they are greater than those to which railway servants, seamen, firemen, &c., with infinitely less pay, are exposed, and they are more often than not of the pitman's own creating. Comparing his position with that of workmen in the majority of other industries throughout the country, he has but little to complain of so far as his share of the good things of life are concerned, and his constant cry for an advance in wages every year, and in some cases oftener, whether the market price of coals admits of it or not, does not say much for his general intelligence or appreciation of fairness, either to his employers or the public.

He knows, or he is taught by the professed agitator, that the public is to a great extent at his mercy, because without coal neither business nor domestic affairs can be carried on, and following the advice of his tutors, he presumes upon the unique position he occupies with relation to the world at large.

It is not our intention to discuss the vexed questions of capital and labour, or supply and demand, but to point to a possible means, slight though they appear at present, by which the perpetual desire on the part of large bodies of workmen for breaking faith with their employers, and "going out" may be somewhat modified if not considerably checked.

We know that the introduction of machinery to take the place of manual labour has always been violently and bitterly opposed by the working man in nearly all phases of life, and we also know that in many of the important industries of this country, machinery, when universally adopted, has been of real benefit to those who denounced it as bringing only starvation in its train. Cannot

a better state of things be brought about amongst mine owners and their grimy pitmen by the substitution, to a certain extent, for hand labour, of machinery—electrical machinery? According to Mr. F. O. Blackwell, who read a paper before the International Engineering Congress at Chicago, it is roughly estimated that some 300 companies in the United States engaged in mining and the kindred arts now employ electricity in their operations, and, as all these plants have been installed within the last few years, it is evident that mining engineers have been quick to appreciate the great advantage of the use of electricity, and adopt it for their many requirements. In underground workings the chance of accident resulting in loss of life and destruction of property is, at the best, great. Humanity and economy both demand that any means that will secure greater safety should be eagerly grasped. It is an established fact that to add to the comfort and facilitate the work of the miner, is to diminish financial risk and increase profits.

Electricity tried under the arduous conditions of mining service has been shown to be peculiarly efficient, safe and reliable. It presents a system of the greatest simplicity, completeness and flexibility, permitting power from one source to be distributed in units of any desired size and for any purpose to the places where it can be employed to the greatest advantage, thereby securing the minimum consumption of power and expenditure of labour. There is no leakage nor loss of power when not in use, which especially recommends it for intermittent work. It is not affected by heat or cold, and does not vitiate the air, as is the case with steam and compressed air. The rapid deterioration of timbering, a source of great expense in all mines, due to bad air and heat, is to a great extent obviated. It has been urged against electricity that it increases the risk of fire. As a matter of fact it greatly decreases it, as the statistics of insurance companies testify. With proper safety devices and a system of concentric wiring it is practically impossible to start a fire from the current.

Electric coal cutters are now largely in use in the bituminous mines, and electric drills for putting in holes for blowing down coal after it has been undercut or from the solid, as is done in anthracite, are also used.

In this country there are employed in several places electrical coal cutting machines, devised and manufactured by Messrs. Goolden & Co., and one of these apparatus, we understand, will do the work of the combined efforts of thirty miners. It requires three or four men only to handle it, but these need not all be to the manner born, that is, workmen who have not been pit hands from their boyhood upwards are quite competent to manage the machine.

The economical advantages of the apparatus, although we cannot give the precise figures, are very great, and the cost of getting the coal is therefore materially lessened; moreover, the electric coal cutter can be most advantageously and economically put to work in places where men could not readily manipulate their ordinary hewing tools.

With machinery such as this to be obtained, it is an open question whether the mine owners would not be acting in their best interests to adopt it generally, for the men would probably regard these machine coal cutters as a very powerful ally to capital, and would possibly think twice before so readily abandoning their labour on the slightest of pretexts. The introduction of these appliances need not necessarily lessen the number of hands employed in and around the pits, for the output could be vastly increased, and for this there is doubtless room.

The use of machinery for manual labour has, as we have before remarked, often instilled very salutary lessons into the minds of rebellious workmen; who knows but that the same effect might be produced here, for there are not wanting those who believe that colliery owners might materially safeguard their interest by adopting such means as we have briefly outlined.

We have made a suggestion; we leave it to those directly interested in procuring our fuel to the best advantage of themselves and the public to decide whether the idea contains the germ of a revolution in coal cutting and the provision for a more amicable and contented state of feeling to exist between mine owners and their men.

ENGINEERING COLLEGES.

THE demand for engineering training has called into existence an array of colleges that seems likely to compete, as years go on, with the lustre of the greatest universities; but some unfortunate exceptions to this general excellence, which have lately come to our notice, make it imperative that those who have sons to educate should examine more carefully the relative merits of the various institutions established for that purpose. The most obvious method of choice is to inspect the buildings, the laboratories, the machinery, and to judge them, as one might a dwelling-house, from the general convenience and architecture; "impressionism" here reaches its superior limit, the fond parent leaves such an institution with the wish that his time could recommence, and he is only consoled by the thought that "a man can't be a child again, and be a father, too."

The efficiency of engineering educational systems—at any rate, in Great Britain—does not depend entirely upon the mere buildings and equipment of the colleges, though these are of acknowledged importance; the truer basis, and the one which we must always be prepared to stand or fall by, in England, is the erudition of our professors and technical instructors. Happily, there is little danger of our ever falling short in this respect, for the existing universities and engineering colleges are turning out men thoroughly able to fill such gaps as may from time to time occur. It is to be regretted that in spite of this there are so-called "engineering schools" where those who are responsible for the teaching are grossly inadequate, and where, as regards the equipment, not even the "impressionist" could be deceived. It is not our purpose here to specify any particular school, our only object is to warn those who intend to attach themselves to institutions of this kind, and we ask all engineers to help us to discourage them by observing for themselves and reporting where necessary. If the subject is "Electrical Engineering," let them inquire how the subject is taught; it would also be well to find out what are the qualifications of the tutorial staff. The injustice to the pupils of these so-called schools calls for a determined action on the part of the Committee of Council on Education, and we trust that Mr. Dyke Acland will find a means of bringing about a reform

by including them in his inspection of educational systems. At the present day there is no excuse for an ignorant tutorial staff in scientific subjects, however low may be the funds.

Apropos of technical colleges, we have lately received an account of the Massachusetts Institute at Boston, in the form of a pamphlet written in connection with the Columbian Exposition. It is essentially a College of Industrial Science, intended to provide a thorough training in civil engineering and allied subjects. The Institute may fairly claim to be one of the earliest technical schools in the world; it was chartered in 1861, and opened to students in 1865. The founder was Dr. William Barton Rogers, formerly professor in the University of Virginia. The funds have been largely supplied by the State of Massachusetts, their total contribution amounting to $200,000; in addition there have been the endowments of Dr. Walker, Mr. Ralph Huntingdon, and others, whose names are closely associated with the building. Judging from some excellent photo-etchings, which form part of the pamphlet, we have to confess that this Institution, at least, from the "impressionist" view, leaves many of our best English technical colleges a long way behind; and when we look through the syllabus of subjects taught, it is evident that America is rightly proud of her position among the nations in the intent for widespread technical knowledge. Unfortunately the pamphlet gives but a scanty idea of the efficiency of the tutorial staff; we are told that they number 125, but it would have been interesting to know something of their names and qualifications; for a college is almost entirely dependent for its successes upon the adequacy of its professors, and it is impossible to give an opinion upon the Institution without having definite information in this regard.

British Association and Congresses in General.

WE think that electrical men do not anticipate that the Nottingham meeting will produce any very remarkable contribution, either theoretical or practical, to electrical science. For one thing, many of the foremost figures at scientific meetings will this year be conspicuous by their absence. The Congress at Chicago has called away many electrical men who will not return till long after the B. A. meeting; those who do return in time will not, after their labours in the States, be overcharged with new ideas or possessed of the mental vigour necessary to take part in scientific discussions. The meetings of the B.A. have year by year become less and less important from an electrical point of view; many hold that they have generally deteriorated, but with that we have no concern. Certain it is that we look in vain to Section G. to give us nowadays something worth travelling over the greater part of the country to hear; the mathematical section, from its constitution, will find something to talk about for a few years to come. There are various reasons why a man takes part in scientific meetings: he may be an official, and, as such, will no doubt make a hurried contribution; he may seek to become better known through his disquisitions, and under these circumstances will talk for ever; he may read a paper because it is expected of him, or he may be badgered into making some communication, but the sole idea of imparting new information impels few men to take part in scientific gatherings. Amid all these meetings and congresses it must not be forgotten that the men who are doing the most important work, and who are daily making fresh discoveries are left at home; they are rarely seen in print, and are seldom in evidence at scientific meetings; yet, these are the men who, without the blare of trumpets, are carrying out real work, and gradually bringing the products of science to exercise greater benefits on mankind.

The "Excelsior" Battery.

WE wonder if the inventor of this new battery, described on another page, can make known what reactions take place with his exceedingly complicated depolariser. The battery does not seem to be anything more than a Leclanché cell when only the manganese is acting. It seems impossible, for instance, to regenerate the chromic acid when the bichromate has been reduced to chrome alum by merely passing air over the mixture; besides this, even the manganese, to take up the oxygen of the air, ought to be heated in contact with an alkali, &c. All the depolarisers of many other batteries seem to have been put together to make this one the "Excelsior." The amalgamation process was known and described many years ago, as well as blowing in air to get better depolarisation.

The B. A. Presidential Address.

THE presidential address of Dr. J. S. Burdon-Sanderson, M.A., M.D., LL.D., D.C.L., F.R.S., F.R.S.E., Professor of Physiology in the University of Oxford, formed a brilliant opening discourse for the Nottingham meeting of the British Association. The subject was certain to arouse interest in the minds of the members of all sections; for "Biology" is a study which, in the limit, just touches the border line of "life" and "volition," which have held a high place in the minds of men since "thought" was first able to conceive of them. "Biology," said the lecturer, "comprises the sum of the knowledge which has yet been acquired concerning living nature; the word was unknown until the beginning of the present century." It, as yet, lays no claim among the exact sciences, but occupies a unique position somewhere between Natural Philosophy and Psychology, with this distinction, that it concerns itself with *organisms* rather than with inert matter. It seems to consist in the study of Physics, *plus* the consequences of the subtle principles of life and adaptation. Science was lifted, by the lecturer, completely out of the rut of utilitarianism where it so often sticks. Following closely upon what Treviranus had said, he held that "to view science simply from the ground of utility, was to narrow it; we ought to dwell rather on its value as a discipline, and on its surpassing interest." This is a position which England flatly denies to science at the present day. "Our country has no imperial university for physical science, no central institution of chemistry on a scale commensurate with the practical importance of that science; and those who desire either to learn the methods of research or to carry out scientific inquiries, have to go to Berlin, to Munich, to Breslau, or to the Pasteur Institute in Paris, to obtain what England ought long ago to have provided. For, to us, from the spread of our race all over the world, the prevention of acute infectious diseases is more important than to any other nation." The claims of pure science were very urgent, but it was necessary to speak "even more strongly of the application of science to the discovery of the causes of acute diseases." The uncomfortable fact remains that "England, the wealthiest country in the world, which has profited more, vastly more, by science, than any other dominion, stands alone in the discredit of refusing the necessary expenditure for its development, and cares not that other nations should reap the harvest for which her own sons have laboured. It is not the fault of governments, but of the nation, that the claims of science are not recognised. We have against us an overwhelming majority of the community, not merely of the ignorant, but of those who regard themselves as educated, who value science only in so far as it can be turned into money."

THE PRACTICAL MEASUREMENT OF ALTERNATING CURRENTS.

LECTURE II.

DR. FLEMING commenced his second Cantor lecture by showing the distinction between inductive and non-inductive circuits. Every electric conductor had the property of producing a dissipation of energy when an electric current is passed through it, and it has also the property, as a natural consequence of the above fact, of producing a fall in pressure in the current passing through it. Considering a continuous current flowing through a conductor, it is found by suitable measurement that there is a fall of potential or "drop" in pressure between the ends. The rate at which energy is being dissipated in that conductor is numerically measured in watts by the product of resistance and the square of the current strength. If, however, alternating currents were used, the product of the resistance of the circuit and the $\sqrt{\text{mean-square}}$ value of the current does not always give the $\sqrt{\text{mean-square}}$ value of the drop in volts; neither would it be always true that the product of the resistance of the circuit and the mean-square value of the current would give the mean value of the power taken up in the circuit. In other words, the "drop" in volts, which would actually be observed in the case of an alternating current circuit, especially if it is a circuit wrapped round iron, is more than can be accounted for by the simple resistance of the wire. We find we have in this case to take into account another quality of the circuit, which is called its "self-induction." In such a circuit, the number by which we have to multiply the $\sqrt{\text{mean-square}}$ value of the current, to obtain the $\sqrt{\text{mean-square}}$ of the E.M.F., is the measure of what is called the "impedance" of the circuit. We can always measure the resistance of a circuit by means of a Wheatstone's bridge, and if taking any circuit we find that, when an alternating current is passed through it, the ratio of the $\sqrt{\text{mean-square}}$ value of the drop in volts, down that circuit, to the $\sqrt{\text{mean-square}}$ value of the alternating current through it, is greater than the true resistance, such a circuit is called an "inductive" circuit, and the above ratio is a numerical measure of its impedance. As an illustration, the lecturer gave the following example: Two wires, one of platinoid and the other of manganese steel, were wound into spirals round a wooden frame. Each of these wires was about 25 feet long, and made 40 turns round the frame. In the first place a continuous current was passed through each wire, and the fall in volts down each wire carefully measured, the current in both wires being ·802 of an ampère. The drop in volts down the platinoid wire was 67·9; and down the manganese-steel coil 79·7 volts. Accordingly, the ratio of volts to current in the first case is 84·66, and in the second 99·38. This being done, an alternating current of the same $\sqrt{\text{mean-square}}$ value, as measured by a Kelvin balance, was passed through the two coils. The fall in volts down the platinoid coil was found to be 68·5, and down the manganese-steel coil 80·7. These were the $\sqrt{\text{mean-square}}$ values. The ratio of volts to current in the first case is consequently 85·41, and in the second 100. These, therefore, are the impedances of the coils, and it is seen that in each case the impedance exceeds the resistance. The frequency of this alternating current was 108; the coils form slightly inductive circuits. If an iron core had been inserted in either coil it would have greatly increased the impedance of that coil. There are many cases in which inductive circuits cannot be employed, but in which we must secure, by some means or other, a practically non-inductive resistance. Such a non-inductive circuit can be formed of a series of incandescent lamps, and for larger currents it can most conveniently be obtained by using rods formed of a mixture of plumbago and fire-clay, mixed in proper proportions to make the necessary resistance, and then baked.

Turning, now, to the question of the measurement of alternating current pressure, the lecturer reviewed the various types of instruments which could be used for the purpose. Electro-dynamometers, which can be wound with very fine wire, so as to make a current-measuring instrument of high resistance, could be rendered suitable, provided that certain precautions were employed. In the first place a high-resistance dynamometer might be made by winding such an instrument with a wire of high specific resistance, and of necessary length. Its impedance would be a fixed quantity, provided that it was always to be used with alternating currents of the same frequency. The readings would indicate the $\sqrt{\text{mean-square}}$ value of the current flowing through it; and hence, by what has been said above as to the definition of impedance, it follows that the $\sqrt{\text{mean-square}}$ value of the alternating current-*pressure*, at the terminals of the instrument, will also be given by those readings. We can graduate such a high-resistance dynamometer for alternating pressure of any given frequency; but if the instrument has an impedance which differs sensibly from its true resistance, then, if calibrated for alternating currents of one frequency, it will not, in general, be identical in its indications for alternating currents or voltages of different frequency. The condition that the impedance of such an instrument shall differ by very little from its true resistance can, however, nearly always be secured; and when once it has been calibrated, by testing it with known unvarying pressures, it will enable us to measure alternating current pressures, giving us their $\sqrt{\text{mean-square}}$ values.

In order to obtain the necessary non-inductive quality in such an instrument, it is usual to place the greater part of the resistance of the instrument in the form of a non-inductive coil of platinoid wire, placed outside; by this means we of course sacrifice its sensitiveness. In Evershed's current volt-ammeter there is a compensation for frequency which is worth noting. The voltmeter coil has in series with it a subsidiary coil, the terminals of which are shunted with a condenser. This condenser has the property of neutralising the self-induction of the voltmeter coil, and if properly adjusted, the instrument may be made to give identical scale indications for alternating pressures of widely different frequencies, and be practically compensated for frequency.

The thermal methods of measuring alternating E.M.Fs. were exemplified by the Cardew voltmeter. It has a platinum-silver wire of about 300 ohms resistance, stretched in a tube; and, for the sake of compactness, the wire is folded, backwards and forwards, four times over small ivory pulleys. The elongation of the wire, when a current passes through it, is multiplied by an inter-gear of wheels and pinions which actuates the needle. There are two types of the instrument called respectively the "rod" and "tube" type. In the "rod" type, which is the easiest to manufacture, the platinum-silver wire is kept extended by being fastened to two rods, formed one-third of iron and two-thirds of brass. The rods do not immediately settle to their definite temperature when the current passes, so that the readings are somewhat tardy. In the tube type, the wire is attached simply to the brass and iron tube which forms the case of the instrument. The outside tube arrives quickly to its final thermal state, and hence the instruments of the "tube" type are preferable for accurate work, on account of the fact that they thus come much more quickly to their readings, when put on circuit. In the manufacture of the instruments the wire has to be previously "aged" by putting current on and off for some time, at intervals of one minute, so as to heat and cool the wire alternately. This gets rid of an uncertain variation in expansion, and the platinum-silver wire is brought to a condition in which it is always the same length at the same temperature. Cardew voltmeters are really alternating current ammeters which take a current of about one-third of an ampère at 100 volts. An instrument of this range therefore dissipates a power of 30 watts, and has the consequent disadvantage of wasting a considerable amount of energy if kept continuously on circuit, but, when carefully made, the Cardew voltmeter is of great value for measuring alternate current pressure.

There are some modifications of the Cardew voltmeter which are useful in measuring very small alternating E.M.Fs. Captain Holden stretches a very fine platinum-silver wire between two supports, keeping it sagged by means of a small spring. To the centre of the wire is attached a thread, which is fastened at its other end to a small mirror; so that if the sag of the wire varies, the mirror is deflected. In this way the heating of the wire is measured as the current passes through it. The instrument is capable of measuring $\frac{1}{100}$th of a volt and upwards, alternating pressure. In such

thermal voltmeters it is necessary to avoid convection currents of air, in the enclosing tube or case. When using a Cardew voltmeter it is generally found best to place the instrument with its tube horizontal; in this way the variable cooling effects of the air currents are to some extent prevented.

The next class of instruments for the measurement of alternating pressure depend upon electro-static attractions; they have, for many purposes, great advantages, the most notable of which is that they consume no energy, and that therefore they may be left on the circuits indefinitely, without cost. Lord Kelvin's static voltmeter consists of four quadrant shaped plates which are arranged as two diagonal pairs, all connected to one terminal of the instrument. The needle hangs vertically, and is connected to the other terminal. The instrument, in fact, forms a condenser of which one set of plates is fixed vertically, and the other movable round a horizontal axis. When a difference of potential, varying from 1,000 to 5,000 volts, is produced between the terminals, the movable plate, or needle, is attracted in between the fixed plates. The movement is resisted by weights, which are hung on the bottom of the needle. The attraction between the plates is independent of sign, so that the instrument works equally well with direct or alternating pressures; in this latter case it gives the $\sqrt{\text{mean-square}}$ value of the potential difference, because the attraction between the plates is proportional to the square of the difference of potential between them.

Another instrument, also invented by Lord Kelvin, but adapted for measuring lower pressures, is the multicellular electrostatic voltmeter. In this instrument there are a series of quadrant-shaped plates, placed one above the other, forming what are called "cells." There is then a corresponding series of paddle-shaped needles—all attached to a common vertical axis—which is hung up by a platinum-silver wire. The normal position of the needles is just outside the quadrants, but if a difference of potential is created between the needles and the cells the needle is drawn, or attracted, into them. This movement is resisted by the torsion of the suspending wire. The indications are from 40 volts upwards, and represent the $\sqrt{\text{mean-square}}$ value of the potential difference between the cells and the needle. In these instruments there may be a very small error in reading, which is dependent upon the existence of a small E.M.F. of contact between different metals. If the cells are made of brass, and the needle of aluminium, there is a small contact P.D., which is due to these different metals, and which may amount to anything less than half a volt. Accordingly it will be found that in such an instrument, reading, say 100 volts, the indication given will depend upon whether the cells are positive or negative, and a small correction has to be applied depending on the manner in which the instrument has been joined up in calibrating it. Other electrostatic gravity voltmeters have been designed to read from 5 to 40,000 volts; in one of these the movable plate is mounted on a balance arm, the other plate being fixed beneath it; similar instruments have been designed both by Prof. Ayrton and Mr. James Swinburne.

The advantage of the electrostatic voltmeters over those which absorb power was shown by the following example:—Suppose a thermal voltmeter to absorb 30 watts, and assume that this instrument is kept connected to the circuits in the dynamo room of a central station all the year round. Since there are, roughly, 8,000 hours in a year, this instrument would dissipate 240 Board of Trade units of electric energy per annum. If we reckon this energy as costing 1d. per unit, it is evident that the instrument will cost 240d. or £1 a year to keep it going. In reading alternate current pressures higher than 100 volts, a transformer has to be interposed between the circuits and the voltmeter, to reduce the pressure. This transformer will also use up energy, and if it takes no more than the voltmeter it will also waste £1's worth of electric energy in the course of a year. A great deal more might therefore be spent upon a static voltmeter at first, and yet effect a total saving in the cost of electric measurements at the station. For suppose the £1 is capitalised at 10 per cent., we can then afford to pay £10 more on an instrument of the electrostatic type than one of the thermal or electro-magnetic type, which wastes no more than 30 watts, if we keep them on circuit always; and there is, consequently, good reason to suppose that electrostatic instruments will ultimately supersede the others.

Electrostatic voltmeters may be adapted to the measurement of alternating currents by connecting them to the ends of a non-inductive resistance, say of platinoid wire, forming part of the circuit. The wire must be so designed that no sensible heating occurs when the current passes; its resistance must also be accurately known. Then, knowing the difference of pressure between the ends, and the value of the resistance, the current is easily measured. In many cases, as in measuring the primary current of a transformer at no load, it is much more convenient to employ such an electrostatic voltmeter and non-inductive resistance than any other method. Suitable non-inductive resistance can always be made by coils of platinoid wire, joined in parallel; and these must be so adjusted that the final temperature they attain is not more than a few degrees above the normal temperature.

NEW SHUNT ARC LAMP.

[COMMUNICATED.]

THIS arc lamp, the production of which has lately been started on a large scale by the firm of Körting & Mathiesen, Leipzic, and which seems destined to supplant the older construction of the same firm, patented in 1889, demands particular interest in consequence of some peculiar innovations.

The fundamental idea of the new construction in different variations has been known for some time past, and consists in the arc being formed and the movement of the carbons regulated by a shunt electro-magnet, with a swinging armature in conjunction with wheelwork, &c.

Lamps constructed on this principle show, notwithstanding the great simplicity of the electro-magnetic disposition, some defects originated by their construction, requiring to be remedied by particular contrivances.

The first drawback is that the armature which, while the lamp is burning, is balanced between magnetic attraction and the pull of the spring. The carbons differing from one another in weight, which is continually changing through the consumption, have the effect of making the armature continually vary its position.

A second drawback, the heating of the coils, gives an increased magnetic resistance, and consequently, with the same potential at the terminals, a reduction of the attractive

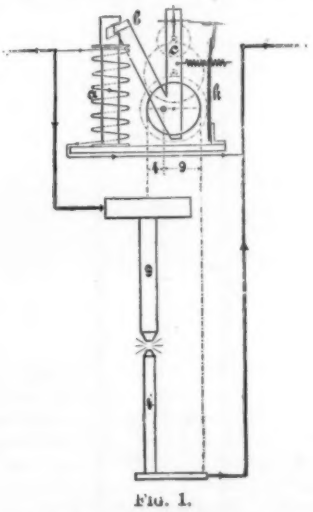


FIG. 1.

powers of the electro-magnet. A greater difference of potential at the terminals is therefore required, to produce on the armature the same effect as when the coil is cold. All shunt lamps, of whatever construction, are more or less subject to this; but the defect, however, does not show so much with lamps provided with magnets having self-acting interruption, as with lamps wherein the feeding of the arc is regulated by a swinging magnet. Whilst the increase of difference of potential of the arc amounts, in the former case, to 2·5 to 3 volts, it is, under identical circumstances, 5 to 6 volts with the latter.

The increase of the difference of potential, in consequence of a decrease of the weight of the carbons, is, in the new construction, compensated for by a lever appliance, as shown in the cut (fig. 1). The armature lever is rigidly united to the wheelwork, the whole system swinging around the turning point of the armature lever; in consequence of which the chain roller has to serve the armature lever as an unequal armed lever in the proportion of 4 : 9. This lever proportion corresponds to the reciprocity of the proportion of the weight of the carbons to one another, consequently the products of length of lever and weight of carbons are equal. The carbons having equal length, and burning off in an equal manner, it is evident that the balance of the load on the armature lever cannot be deranged during the whole time the carbons are burning.

The increase of the tension of the luminous arc, caused by the heating of the coils, is balanced by a compensation band, K. This consists of two strips of metal soldered together, of very different expansive power; for instance, steel and zinc, which, in its normal state, is straight, but bends when heated. The band being screwed fast at its lower end, the upper end bearing the catch must produce a certain deviation, as indicated in the cut. This deviation corresponds as exactly as possible to the receding of the armature, *b*, caused by the heating of the coils, from its

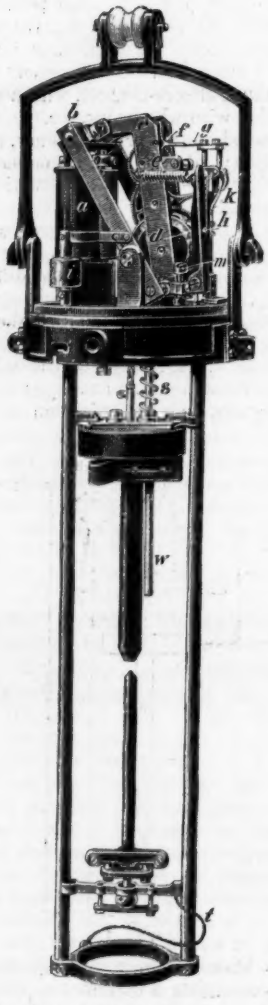


FIG. 2.

original position when they were cold, so that the adjustment of the armature remains relatively unchanged, the difference of potential of the arc not varying either.

Prof. C. Heim, of Hanover, has lately submitted several of these arc lamps to a test, and says:—"Upon the whole, the potential at the binding posts is at the second measuring less by 0·6 volt than at the first. The average of the two latter numbers is 37·0; the first test producing 36·4 volts. Whether the difference is in both cases to be attributed to the different length of the carbons remains doubtful, the difference being so very small. There is no mistake that by using shorter carbons there will occur less loss of potential, in consequence of the resistance of the carbons, than when they are longer, and the amount of the difference found is a proof that it ought to be attributed to the lesser resistance of the carbons." With the caloric compensator, Prof. C. Heim has obtained the following result:—"Finally, the amounts of the average tension distinctly show the effect of the 'compensator' preventing a considerable increase of the potential in the course of the burning-time of both lamps. The greatest difference between all the amounts obtained are as to lamp 1, 1·0 volt; as to lamp 2, only 0·5 volt."

The favourable effect of the contrivance shows still more distinctly in the result of experiment 4. (In this experiment a lamp of the same construction, but without a compensation band, was examined.) In proportion as the potential increases through the coils heating during the first $1\frac{1}{2}$ burning-hours by, say, 5·5 volts, the contrivance has the effect of altering the tension by nearly 5 volts in the lamps to which it is applied.

The swinging magnet, *a* (fig. 2) attracts its armature, *b*, into a lateral slot of the pole-pieces, against the spring, *e*. The roller, *d*, of the wheelwork, *c*, carries a chain, to which are attached both movable carbon-holders. As soon as the lamp is connected with the circuit the armature, *c*, penetrates completely into the slot, thus setting free the wheelwork arrested by the fly regulator, *f*, and the catch, *g*, and bringing together the two carbons which hitherto had been separated by the greater weight of the upper carbon. When the carbons meet, the magnet, *a*, loses its current, releases the armature, and forms the arc; the chain roller, *d*, participating in the rotation of the armature lever, and the armature remaining balanced between magnetic attraction and pull of the spring, *e*.

The movement of the carbons is regulated in the following way: When there is a maximum tension at the arc, the armature, *b*, is attracted into the opening of the pole-pieces so far as to allow the fly regulator, *f*, to become released from the catch, *g*, which allows of a slow approach of the carbons, checked again the next moment by the arresting of the winged wheel.

The regulation of the tension at the arc is effected by the spring, *e*, adjusted by means of the lever, *h*, and the screw, *m*. The dash-pot, *i*, moderates the movement of the armature, *c*. The current is conveyed to the upper carbon holder through a movable spiral, *s*, steadied by the bar, *w*.

The chief advantages of this lamp for practical use consist in the facility of regulating the tension of the arc, exclusively performed by the adjustment of the spring, *e*. By adjusting the proper tension of the arc, the right adjustment of the formation of the arc is simultaneously effected.

Since this lamp burns from the very beginning at the proper tension, it gives the advantage of burning always with the same intensity of light, and with an economy of current which, especially with central stations, is of importance.

Another, even greater advantage, is that two of these lamps, with as low a tension as 100 volts, continue burning in a steady way, thus, it is claimed, surpassing in this point all other shunt lamps, wherein, with the increase of the tension of the luminous arc, either by the too low tension in the beginning, or the too high tension at the end, disturbances cannot be avoided, for the lower the potential of the working current, the narrower are the limits within which the tension of the lamp is suffered to operate.

Since this lamp is a pure shunt lamp, without any main current coil, it is equally, as nearly as possible, independent of the power of the current, as far as the current conducting parts, carbon holders, &c., allow.

The independence of the power of the current imparts to this kind of lamps, by its adaptability to the wished for intensity of light, a universal merit, which is of great importance to contractors.

Some further advantages of this lamp consist in the circumstance that it is focussing; the hood can be easily taken off whilst the lamp is burning, and the armature is insulated from the body of the lamp.

Prof. Dr. Heim concludes by saying: "Upon the whole the tested lamp, as to construction and sure working, must be considered as pertaining to the very best constructions in

FIG. 3.

existence, as far as this fact can be ascertained by experiments performed in a laboratory. None of the shunt lamps tested by me have given better results."

Fig. 3 shows an outside view of one style of lamp globe.

OCEAN TELEGRAPHY.

THE recent paper of Prof. Silvanus Thompson on the subject of ocean telegraphy seems not unlikely to mark an epoch in the history of the subject. The progress which has been made in the direction of increasing the working speed of long cables has, up to the present, certainly not been great, and there are few, if any indications that any marked increase is likely to be derived from any special arrangements of the signalling apparatus; the suggestions of Prof. Thompson that a solution of the problem is to be found in the design of the cable, though bold, are apparently founded on sound premises, and it would, perhaps, be rash to say that the practical difficulties in carrying out the ideas are insuperable. It is probable, at the same time, that the author has greatly underrated the difficulties in the way of practically carrying out the theoretical suggestions, seeing that his experience of cable manufacture, laying, and maintenance, is of the very smallest, but nevertheless we shall be surprised if the result of the paper will not be to set cable manufacturers and those allied to them, thinking; anyhow the theoretical possibility is a powerful inducement to the engineer to find a practicable way of realising what is certain to afford a golden harvest if successful.

Says Prof. Thompson in his paper: "The only effective way to annul the retarding effects of a *distributed* capacity is to apply a *distributed* remedy; that is to say, abandoning the idea of compensating it by devices placed at the ends of the cable, means must be sought for applying compensating devices *distributively* along the length of the cable, either at intervals or continuously.

"It is well known that the effects of electro-magnetic induction are, in a sense, reciprocal to those of capacity, and it is obvious that if electro-static capacity can be used to correct the effects of electro-magnetic induction, conversely it will be possible to use electro-magnetic induction to correct the retarding effects of electrostatic capacity.

"The practical problem is how to provide compensators having a sufficiently great time-constant without their constituting unwieldy enlargements of the cable. This is a very simple matter of construction. The author has tried several species of devices, some of them resembling elongated 'Hedgehog' transformers made very long and thin, and wound with one coil only of fine wire; others consisting of 'shell' transformers elongated into a very long, narrow loop; others again consisting of simple iron wire, straight or looped, or of wire over-wound with a layer of iron wire. The self-induction, for example, of a 1-millimetre iron wire, over-wound with a layer of iron wire 3 millimetres deep, is roughly about 0·1 henry per kilometre; and its resistance is 144 ohms. One point in favour of the use of loaded straight wires as self-induction devices is the circumstance that the compensator need not join two adjacent points in the two conductors within the cable, but may lie across. This construction, which is specially suitable for cables of moderate length, resolves itself into a three-wire cable, of which one wire is loaded in some way to give it self-induction and resistance, and is connected at intervals alternately to the other two, as in fig. 1."

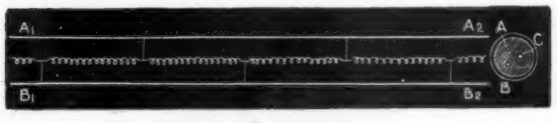


FIG. 1.

Coming next to the question of solving the problem by means of "mutual induction," the kind of induction coil which naturally suggests itself as suitable for the purpose in question is something of elongated shape, such as a very elongated loop "shell" transformer, or the "cable" transformer which was suggested for electric lighting purposes by Messrs. Siemens & Halske some years ago. Or, as the author suggested in 1891, by using a mutual induction between the wires of the cables themselves by merely enwrapping them, as they lay side by side, with iron. So that the cable once more becomes an arrangement of three parallel wires, of which two are specially brought into mutual inductive relations to one another, and are joined up at intervals, as indicated in fig. 2.

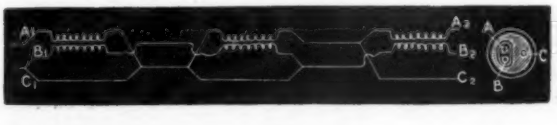


FIG. 2

Referring to the practicability of his theoretical suggestions, Prof. Thompson remarks: "With the facts already known that the Varley shunt does indeed operate at the ends of a cable to compensate in some measure the effects of capacity near those ends, and that on long landlines the speed of signalling can be increased by inserting a translator in the middle, or even by a mere leak at some intermediate point, it is remarkable that no one should have suggested hitherto the very simple solutions now proposed. Perhaps the reason is to be found in the intense horror with which all good telegraph engineers regard the idea of having a fault on their line. Deliberately to insert, as the author proposes, a series of faults, as shunts across the cable from the going wire to the return wire will, to many of them, appear sheer madness." It is difficult to know from where Prof. Thompson has got this erroneous notion, for erroneous it is; no good telegraph engineer ever raised any objection—quite the contrary, in

fact—to a "leak" (or series of leaks), which is what Prof. Thompson means by a "fault," but which good telegraph engineers certainly do *not* mean. By a fault is meant a leak which continually varies in resistance, and which is continually upsetting and distorting the signals. This is certainly not a desirable thing to have on a line.

ELECTRICAL ENGINEERING AT THE WORLD'S FAIR.

[FROM OUR SPECIAL COMMISSIONER.]

XI.

COAL-CUTTING MACHINES.

THE transmission of power electrically, in mining work, has been and is being adopted with remarkable success in America. Hauling, boring, pumping, and coal-cutting machinery are shown by several firms working by electricity.

Coal-cutting by machinery has a much wider application in America than anywhere else. The coal seams are much thicker, and much more room for handling machinery can be provided.

Among the coal-cutters the most novel and best adapted for electrical driving is the one shown by Messrs. Wantling and Johnson in the mining section, and illustrated in fig. 1. The cutters are carried on two wheels, *a*; these wheels are mitred into a pinion on the end of a shaft carried in rod, R, as shown in diagram, fig. 2, so that a high speed on this

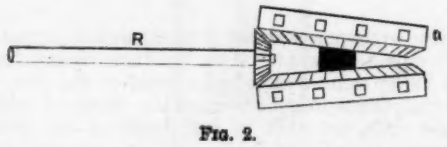


FIG. 2.

shaft is necessary, thus obviating the use of gearing. The shaft slides through a collar and is feathered into this collar; the collar is driven by the motor, M, and the rod can be fed forward, either quickly by the handle, H, or slowly by screw-feed, *b*.

The motor most suitable for mining work is undoubtedly the multiphase motor, having no brushes and no commutators; yet none of the coal-cutters here shown have adopted these motors. The motors shown on these coal-cutting machines are fairly well designed machines of ordinary construction.

In this machine the motor is hung on the end of the swinging frame and counterbalances the cutter rod and head. This machine is especially adapted for perpendicular cuts or driving entry. It can be lowered in the cutting to ditch the entry, if necessary, for taking up the bottom or letting out water of the mines. At the same time it is so arranged that it can be turned obliquely for the purpose of turning the rooms, which will be a great saving to the coal operators in room turning. It can also be operated for a bench mining machine, as the cutting head can be turned from a vertical to a horizontal position. The beauty of this machine is the labour-saving part, requiring only one man to watch its operation as the rotary motion throws its own dirt out of the cutting. The machine is always on the truck, never having to leave the track. Any practical coal operator will see that this machine is adapted for any vein of coal, thick or thin, long or short cuts, as desired. The machine cuts a vertical channel in the coal of any desired depth. The vertical height of the seam by raising and lowering the cutting head by a simple appliance for that purpose. The channel cut in the middle of the entry is tapering from 10 inches wide at the opening to 6 at the finish. While the machine is always on the track the entry can be kept straight.

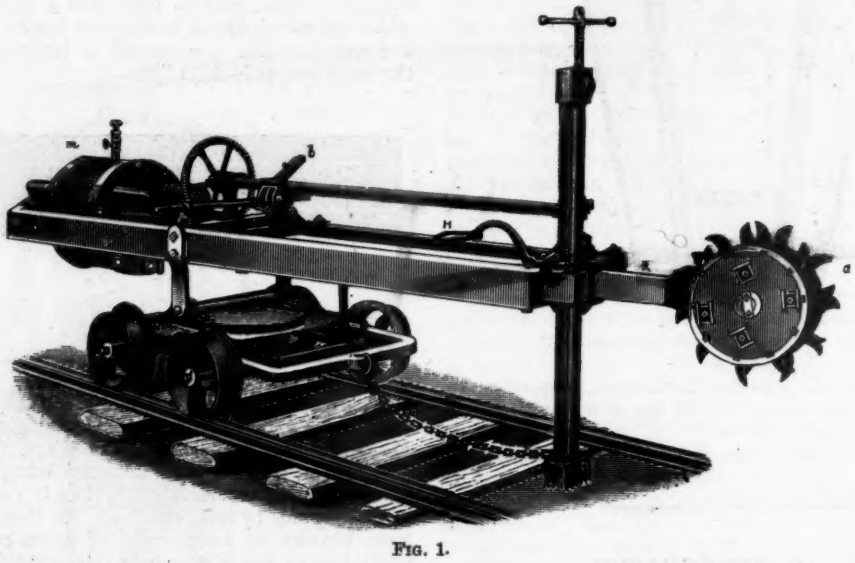


FIG. 1.

This machine cuts 18 inches in diameter, but any size can be built.

It might be objected to this machine that the large cut taken out by this form of head would produce a lot of slack coal, but it is explained that the cuttings are of considerable size and therefore useful coal.

Another coal-cutting machine specially adapted for electrical driving, and one which has been very successful in America, is the Jeffrey machine—a machine for undercutting only. The cutter is a bar carrying a series of cutters. This bar is carried on the front of a sliding frame, and is driven by chain gearing; the frame carrying the bar is advanced slowly as the cutters enter the coal. When the frame carrying the bar has advanced full length into the coal it is rapidly withdrawn, and the whole machine moved along the length of the cutter bar, so that a new cut may be taken.

Fig. 3 is a view of the Jeffrey coal cutter at work; two men are required to work it. The machine itself is built on two stiff girders, forming a frame, lying flat on the ground when at work, and braced by struts and screws at both ends, as shown in the view. To move the machine from place to place a separate flat truck is provided.

The pressed air motor has been preferred to electric motors, in some cases, it is argued, on account of its ventilating the workings. That argument can have very little weight, if any, attached to it. The ventilation of mines must be provided for in the usual manner, whatever motors are employed. No

miner would ever think of depending on the supply of air throughout his workings being supplied by his motors. If the ventilation of the mine is all the pressed air motor has to recommend it, then it must assuredly disappear before the electric motor.

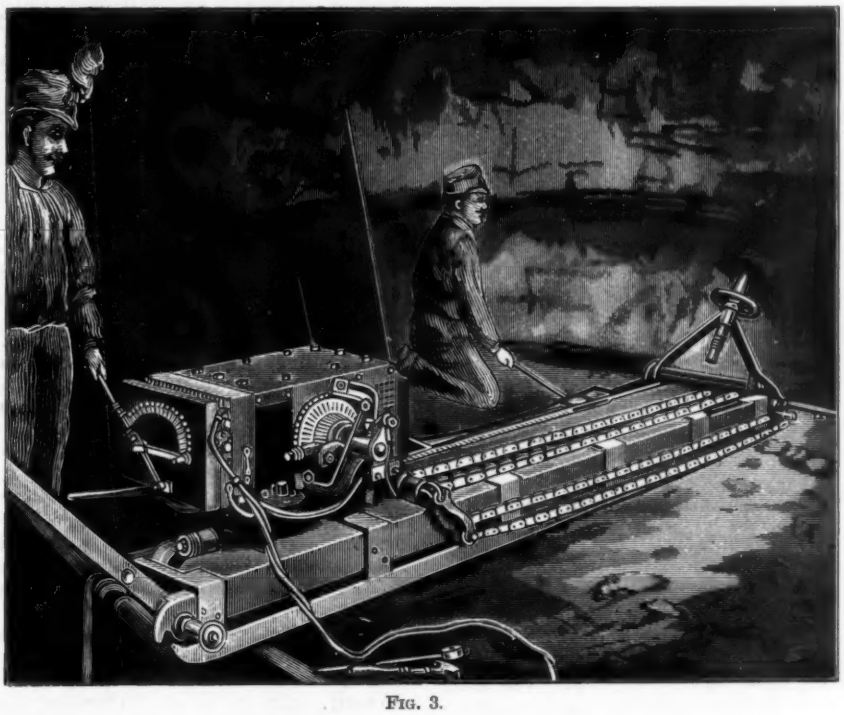


FIG. 3.

The motor, however, must be of that class requiring no brushes and no commutator, and therefore no other attention than lubrication; commutators and brushes are quite out of place on a motor in a coal or other mine.

DISTANCE AND ELECTROMOTIVE FORCE.*

MR. L. B. STILLWELL has recently prepared for the Westinghouse Electric and Manufacturing Company a pamphlet on the transmission of power, which has much more the character of a technical treatise on the subject than of a trade publication. We abstract the following on the relation between the E.M.F., distance, and amount of copper of a transmission line.

"The distance over which power can be transmitted electrically depends primarily upon the electromotive force which may be safely and judiciously employed. One of the factors entering into the cost, and, consequently, into the annual charges of an electric plant, is the investment in conductors between generator and motor. This cost increases—other things being equal—with the distance, and it increases, not in direct proportion to the distance, but in proportion to the square of the distance. In other words, with a given electromotive force, the transmission, at a certain efficiency, of a fixed amount of energy requires four times as much copper if the distance be two miles, as is necessary if the distance be one mile. On the other hand, the amount of copper varies inversely with the square of the electromotive force employed; that is to say, if the distance and other conditions, except the electromotive force be fixed, it will require one-fourth as much copper to transmit a certain amount of energy if 2,000 volts be used as will be required to transmit the same energy with equal efficiency over the same distance if 1,000 volts be employed; and it will require one-hundredth as much copper if 10,000 volts be used as will be necessary if the potential be limited to 1,000 volts.

The great economy in conductors resulting from the use of high potentials will be understood upon examination of the curves of fig. 1, which show the cost of copper required for the delivery of one mechanical horse-power at a motor shaft with 1,000, 2,000, 3,000, 4,000, 5,000, and 10,000 volts respectively at the motor terminals, or at the terminal

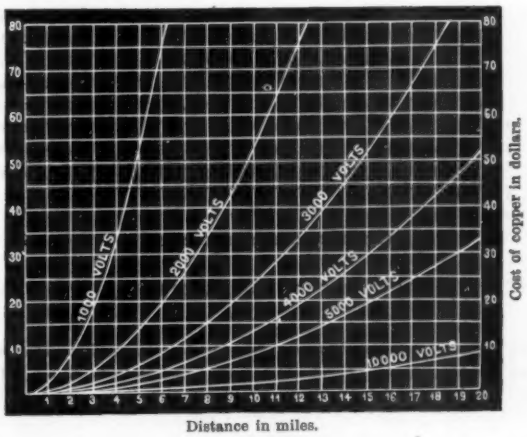


FIG. 1.

of the lowering transformers, with a loss of energy in the conductors (drop) of 20 per cent., distances of from 1 to 20 miles, and a motor efficiency of 90 per cent. The length of conductor per mile of single distance is 11,000 feet, to allow for sag. The cost of copper is taken at 16 cents per pound. The abscissæ represent distances in miles from generator to motor, and the ordinates the cost in dollars per horse-power delivered at motor shaft.

The cost of conductors depends not only upon the electromotive force employed, but also upon the loss of energy allowed in the circuits. The curves of fig. 2 show the cost of copper required to deliver 1 mechanical horse-power at a motor shaft with varying percentages of loss in the conductors, upon the assumption that the potential at motor terminals is in each case 3,000 volts. The distances are 1

* New York *Electrical World*.

to 20 miles and the motor efficiency 90 per cent. The length of conductor required per mile of single distance is 11,000 feet, to allow for sag, and the cost of copper is assumed 16 cents per pound. In this case the abscissæ represent distances in miles from the generator to the motor, and the ordinates the cost of conductors in dollars per horse-power delivered at the motor shaft.

The curves illustrate the necessity for the use of high potentials in transmitting power over considerable distances. For example, from fig. 1, we find that to deliver

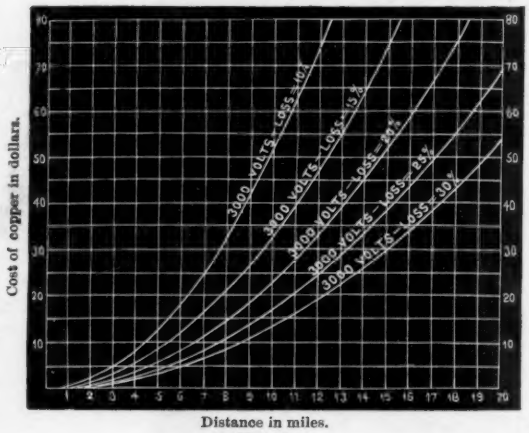


FIG. 2.

1 mechanical horse-power at the pulley of a motor located at a point five miles from the generator, allowing a loss of 20 per cent. in the transmission circuit, it is necessary to invest about $50 in copper conductors if the potential at the motor is limited to 1,000 volts. To deliver the same amount of power at the same percentage of loss at a distance of 10 miles will, if the same potential be employed, necessitate an investment of $200 in copper.

Transmission over great distances may be accomplished by the use of very high potentials, and for any given distance the investment in copper conductors decreases rapidly with increase of potential; but it must be remembered that the difficulties encountered in proper construction and insulation of the circuits will increase as the potential is raised. A plant should be so installed as to practically obviate all danger of interruption of service; and, therefore, the potential selected in any given case, while high enough to secure reasonable economy as regards investment in conductors, should not be so high as to involve any undue risk of reliability of operation.

ELECTRIC TRAMWAYS.

IT is always an interesting duty to be able to record progress in the adoption of electric power on tramways at home, but there is, unfortunately, very little in this direction being accomplished; and many people often wonder, in reading of the opening to passenger traffic of new electric tram lines on so near a place as is the European continent, "how the thing is done." There is no mistaking the fact that material development is taking place in this direction, both in Germany and in France, particularly in the former country, as a perusal of our Notes columns during the past few months will amply testify. Here, in this country, we have various firms who would be very glad to undertake traction work; but of orders there are, at the present moment, practically none, and wishful contractors regard with somewhat moistened eyes the rapid strides now being made across the Channel. It may be well to investigate this matter, which is of considerable importance to the British electrical trades.

For all practical purposes, the continental industry in the supply of plant, and the equipment of electric tramways, is entirely in the hands of some half a dozen firms; for instance, the Thomson-Houston Company in France, and the same concern in Germany, in the form of the Union Elektricitäts Gesellschaft; Messrs. Siemens & Halske; the Allgemeine Elektricitäts Gesellschaft; Messrs. Schückert & Co., and Messrs. Ganz & Co., of Buda-Pesth, for Austria-Hungary. From these firms have emanated schemes—some of which have been carried out—for the construction of electric tramways in various parts of Germany, France and Austria. Among these may be mentioned Bremen, Hanover, Chemnitz, Plauen, Remscheid, Essen, Barmen, Havre, Berlin-Charlottenburg, Buda-Pesth, Vienna, Frankfort, Dortmund, Nordhausen, Paris, Dresden, Nurnberg, Gera, Hamburg, Elberfeld, and many others which one cannot call to mind for the moment. These projects, or rather those that have not yet been put into execution, have been elaborated with the real intention of the work being proceeded with, and operations are being pushed on as rapidly as possible; and, if our information be correct, the makers of electric tramway plant in Germany at the present moment are exceedingly busy—so busy, indeed, as scarcely to be able to meet requirements. At Havre, some 40 cars are to be put in operation, whilst at Remscheid the number of cars in service is to be increased to 12 in consequence of the large accession of traffic due to the more rapid means of transit and the moderate fares.

Taking Germany as the most important and typical case, there are three reasons that may be adduced as the cause of the present progressive movement in electric traction in that country. The first is, that tramways are none too numerous, and, therefore, there are many openings for new lines. The second is, that certain financiers—not the usual type of continental "bankers," who are as plentiful as flies in summer—have confidence in electrical traction enterprises, and they are prepared to co-operate with electrical firms in bringing them to a successful issue; and the third reason is, that the local authorities generally are very favourably disposed towards electric traction, even to the extent of subscribing capital, as at Remscheid, where one-third of the money required for equipping and working the line recently started has been provided by the Town Council.

The state of affairs prevailing in the United Kingdom is, however, entirely different. There are, at present, few openings for new lines, and he would be a fortunate man who, under existing circumstances, could induce a tramway company to lay out money in the construction of new lines, leaving out of consideration the extension of any now at work. In fact, with some tramway companies it is as much as they can do to keep straight; they are neither prepared nor able to borrow money, and with the onerous conditions of the Tramways Act, 1870, staring them in the face, there is scarcely a board of directors in the country who would care to meet their shareholders with proposals for new capital expenditure to any extent, having enough to manage with the lines now under their control. It is impossible for the tramways to obtain fresh capital for desirable extensions of existing lines, and the mileage of lines worked, instead of increasing, has diminished during the past two years. Until the Tramways Act, 1870, is amended, there seems very little chance of electric traction being much adopted, or the cost being met, by tramway companies themselves.

An important matter is the position of the local authorities. The latter can, according to the Tramways Act, 1870, acquire the tramways at the expiration of 21 years, and there seems to be a widespread opinion among those who are not now owners of tram lines—and of the 946 miles in operation in the United Kingdom no less than 261 miles are the property of the local authorities—that they should become possessors of the outstanding lines. This is, however, not all; they desire not only to be the owners, but also, to a certain extent, to be able to work them, which they are at present prohibited from doing by Section 19 of the Tramways Act, 1870. A Bill was, however, brought in a few weeks ago to authorise local authorities to work tramways; but for certain reasons it was withdrawn, and another Bill is to be introduced in its place. Nevertheless, there seems to be little doubt that before much time elapses, local authorities will be permitted to work their own lines and those that they may acquire. It is to them that the promoters of electric traction must look for the most work. Some of the local authorities—probably the majority who have been approached on the matter—are in favour of electricity as the motive power, and it is to them that most attention should be paid.

It must be shown—and it can be demonstrated beyond question—that traction by electricity is cheaper than horse

haulage; and it is important that a saving should be made manifest, otherwise what inducement is there for a conversion from one system to another? It is this important point that is so frequently lost sight of, but which should always be borne in mind when approaching local authorities. After municipalities, the work of pushing on electric traction will also devolve upon the traction companies themselves, who, in addition to undertaking contracts, will have to assist in the provision of capital for new enterprises. The outlook at the moment is not very bright, but with the recent model clause, recommended by the Joint Parliamentary Committee, before us, and the preparations being made in two or three directions, there should be in the course of a year or so a remarkable progressive movement in the use of electricity on tramways in this country.

STEAM ENGINE EFFICIENCY.

OUR American namesake prints a paper by Mr. N. H. Bryan, which deals with the question of practical steam engine efficiency as distinguished from what may be called the expectant efficiency. There is not much which is original in the paper; it is somewhat of a *résumé* of the mechanical reasons in favour of multiple cylinder as distinguished from simple working. It is probable that nine out of ten young engineers, barely out of their pupilage, would be found to design a steam engine on the basis of excessive expansion, and therefore much too large for its work. This tendency to over refinement is, we may hope, natural in most young engineers, and infinitely better than the opposite habit, for it indicates at least the spirit of good intention. Experience modifies his attempts, for he learns to make allowance for the many drawbacks which are found to exist in actual every-day work, and we believe that it is in the rough and tumble of daily work that the multi-cylinder engine finds its opportunity of acting up to its trial performances better than the simple engine. We are quite at one with Mr. Bryan in his faith in the "heat trap" theory of the compound engine, and the use made in the later cylinders of the steam produced during the latter portion of the stroke in the earlier cylinders, but at the same time we do not think sufficient allowance is made for the mechanical effects of the compound engine, or rather the dimensional effects. It is not merely that there is a reduction of the range of temperature in any one cylinder, but there is also a reduction in the pressure difference on the two sides of every perimeter of leakage. Compounding does not merely save the steam which leaks past the first valves and piston, but it reduces first the length of the circumferences at which leakage can occur, and it reduces the net pressure at which leakage can occur at such diminished length. This brings us to emphasise the folly of that system of compound working which appears to aim at doing everything very well in the first cylinder and leaving the last cylinder to take care of itself. Now as a fact the first cylinder only wants to be kept warm, and it does not require to show a specially well formed indicator card, though it should be large enough to call for some expansion of the steam. On the other hand the final cylinder must not be left to act as a steam pump, drawing steam from the first cylinder right through its stroke. It must have as good a valve gear as the first cylinder, and must use this to choke back the steam against the first piston to a considerable degree of pressure, thereby securing the above-named smaller net leakage pressure on the H.P. piston and valve. This method of working, the present writer has insisted upon for years, and secured good economy by introducing it wherever he has found opportunity of doing so. It has lately been flourished in America as a new discovery there, but it is of old standing in the English manufacturing counties.

Mr. Bryan introduces a table made up from a few tests of standard types of engine, showing not simply the actual efficiency of these, but the ratio which their secured efficiency bears to the perfect engine efficiency. The efficiency of the so-called perfect engine is always a fractional number, for it represents the ratio of the heat actually used to the heat in the steam, though it is well known that the engine of unit efficiency does not exist in even true theory, and it would seem better that the efficiency of the real engine should be unity rather than that it should be expressed by its relation to the thermo-dynamic engine.

In Mr. Bryan's table, are three efficiencies—Column A, the efficiency of the engine relative to the heat in the steam; column B, the efficiency of a perfect engine working between the limits of temperature of the actual engine; and column C the relation of A to B, which varies from ·500 for single cylinder condensing Corliss engine to ·769 for a non-condensing Corliss. Column C, in fact, shows to what extent each engine has utilised its opportunities, and naturally, a good non-condensing engine comes out best, though we think the table too narrow in its foundations of facts to warrant definite conclusions being drawn therefrom, especially as the two examples of triple engine have only an initial of 140 lbs. absolute—too low for anything more than a two-cylinder compound. Triple expansion, as a practical fact, seems to us to be largely a question of the length of time an engine must run without attention, for upon a long run the advantages pointed out above with regard to leakage come into play.

Thurston is quoted as authority for a table of total expansions and limits of pressure for engines, up to five cylinders, the ratio in each case, except for the simple engine, being three expansions per cylinder. For a quintuple cylinder engine, this implies 243 expansions, or 3^5, and 2,430 lbs. initial pressure, while the quadruple engine is given 810 lbs. pressure, the pressure being in every case given as tenfold the total expansion.

Putting marine work aside, we think it extremely doubtful if there are many existing places where a commercial economy is being secured by anything more advanced than the two-cylinder compound engine, and in commercial economy we would be understood to include a consideration not alone of running expenses and repairs, but of boiler renewals and the business disturbances liable to ensue therefrom.

To revert to the subject of efficiency: we speak of an engine having an efficiency of ·156 or ·184 with respect to the total heat of its working fluid referred to the absolute zero, and we do so knowing all the time that we can do no real good by lowering the final temperature below about 100°, and that even were we able to secure a condenser temperature of 0° absolute, we should be quite away from any result better than we secure with 100° final temperature, for the simple reason that we have in steam a working fluid which ceases to exist, as even an approximate gas, long before the absolute zero is reached. Indeed, we may very fairly consider 100° to be the absolute zero for water vapour or the limit of the air pump, and if efficiencies were computed on this basis, we should be better placed for realising just how far short of the possible any engine was actually working.

It is to the professional ranks that is due so much of the deference to the absolute zero—a fetish which, among others, they set up as a warning or defence against baser intrusion, much as medical men prescribe aq. pura, and other simples, sounding much and signifying nothing.

SMOKE PREVENTION.

BY W. H. BOOTH.

DEVICES for preventing the out-pouring of smoke from steam boilers are very numerous—perhaps we should have written "professing to prevent." It is, nevertheless, exceedingly difficult for a layman, or even for an engineer who has not given special attention to the subject, to secure reliable information as to the merits of different apparatus. One reason for this is to be found in the fact that most smoke prevention devices are the vehicles by which their vendors make their living, and there appears to be a general rule amongst business people to look upon competitors as so many pirates to be starved out or otherwise disposed of, in which process very little consideration is given to a strict observance of accuracy of statement in decrying the appliances of competitors. Of two makes of mechanical stokers, for example, the one explains away the smokelessness of a competing machine by pointing out that this virtue only comes into operation at a certain hour in the morning, previous to which the production of dense black smoke is so appalling as to far more than

counterbalance the latter-day praiseworthiness. On the other hand, reversing the position of these two men, the production of a light smoke throughout the day is declared by the competitor as far worse in the aggregate than an occasional minute or two of black smoke, such as occurs during, say, hand firing.

In mechanical stoking the endeavour is made to establish a continuous action, whereby, having once found the proper proportion of air to fuel necessary for perfection combustion, the same may be adhered to all day. Apart from machines or other appliances for smoke prevention, dilution or distribution, there are frequent little points requiring attention which are entirely overlooked. In the first place, it is scientifically rather hazardous to carry on the combustion of a smoky fuel in a vessel from which we are abstracting heat during the period of its generation. This is done in flue boilers by burning the coal within a water-jacketted furnace, and in water-tube boilers by covering the furnace with tubes full of water. It is equally incorrect to expect the air supplied through the grate to be sufficient to complete the combustion of the hydrogens evolved above it, and it is useless to admit air in bulky streams above the grate, even if the quantity be correct.

Given a non-absorbent furnace, as of firebrick, and a sufficient length of non-absorbent flue, and it is certain that perfect smokeless combustion would be assured with the proper amount of air, however admitted; but in practice we do not have the non-heat absorbing surroundings. It is true that, given a fairly good draught, bituminous coal can be burned smokelessly in the Lancashire boiler by hand firing if this be moderate and frequent and a regulated air supply be admitted by a perforated door. In such a case the air travels over the fire, mixes with the gas from the coal and becomes heated to 1,000° Fah., which is the lower limit necessary for ignition. This ignition takes place at the bridge end of the furnace and with other favourable conditions smokelessness will be secured. But there are conditions which will stop this desirable result. Should the draught be of a vibratory order, smoke will still be made, and it is not always easy to detect the cause of such vibration. The writer has known it cured by slight changes in the brickwork of the flues, which an inspection proved to be badly designed, and many of the most modern steam boilers are to-day faultily set in this respect, and will have tremulous draughts and produce smoke. Similarly the placing of cross-water tubes in the flues of Lancashire and Cornish boilers will often be a reason for smoke being produced. These tubes are useless either as aids to strength or evaporation and ought never to be employed. Bituminous coal cannot be burned smokelessly upon a grate when the products of combustion rise directly from the grate and pass away, as in water-tube boilers, to the heat absorbing surfaces, for the gases are cooled below the ignition point before they can be mixed with the oxygen necessary for their combustion. A boiler fitted with forced draught admitted to the ashpit will smoke because no air can get into the furnace above the fire. Similarly when the draught is poor, air will not enter through the doors unless assisted by a steam jet. The steam jet thus prevents smoke simply by inducing air to enter the furnace, though there is also strong evidence that steam is itself a great aid to combustion, if not a necessary ingredient in every smokeless furnace, owing to some occult chemical action.

One of the most useful appliances to a steam boiler is the ashpit damper. The ordinary flue damper is absolutely useless for regulating the air admission to the fuel by way of the grate or by the door. If the flue damper be so little open as to check the draught very considerably, and a fresh charge of fuel be thrown upon the fire, the evolution of gas will be nearly as rapid as it would be if the draught were unchecked; but, the draught being reduced, the air, admitted to consume the gas, will not enter the furnace, and smoke is inevitable. If, however, the flue damper had been left open, and ashpit dampers provided, the combustion upon the grate could have been checked to any desired amount, and yet when fresh fuel was added there would have been no check to the entrance of air at the now opened air entrances in the door, and the gases would have been properly burned. Without ashpit dampers no intelligent handling of the fires is possible, and yet these dampers are very rarely seen, the flue damper being by far the more common type. We would not abolish the flue damper, for it serves a useful purpose and may be used with care to regulate the general working of the boiler, but, as a rule, the position of the flue damper having been once ascertained, all the periodical regulation, such as called for by the exigencies of smoke prevention, requires to be performed by the ashpit damper, for by it alone can the proper proportions of air be admitted above the fire or below the grate.

Even with the best of damper arrangements, a sluggish drift of 15 feet per second, or less, usually calls for some further means for the purpose of urging the entrance of air by way of the door grids during the period of evolution of gas from a fresh charge of fuel. Some idea of the large volume of air requisite to combine with the hydrogens of a fresh charge of fuel may be roughly gained by taking the gas companies' output, per ton of coal, of 10,000 cubic feet, which is equivalent to an output of 250 cubic feet from an ordinary charge of fuel of half a hundred weight.

As the air for this will have a volume five-fold that of the oxygen chemically necessary, some idea may be formed of the cooling effect upon a boiler and its flues, when so great a volume of air is allowed to enter after the reason for its entrance has disappeared, *i.e.*, after the green charge of fuel has been coked. It is a disputed point if any economy arises from smoke prevention; we are inclined to think there is economy where close attention is given to the air supply above the fuel and its proper shutting off. Similarly, mechanical stokers, when working well, ought to secure an economy if they can be brought to a condition of minimum air supply. It cannot be too clearly understood that the commonest cause of inefficiency in a furnace is excessive air supply, and want of suitable means to regulate this. Hence, we commend the consideration of ashpit dampers to steam users.

RESEARCHES ON THE LECLANCHÉ CELL.

WITH a view to elucidating the action of the Leclanché cell, Mons. A. Ditte has recently investigated a more simple case than that which the ordinary cell presents, namely, a couple consisting of a rod of zinc and a plate of platinum immersed in a 10 per cent. solution of sodium chloride. The results of his observations formed the subject of a communication to the Paris Academy of Science (*vide Comptes Rendus*, cxvi., pp. 812—815), and were briefly the following:—

After the circuit has been closed for a few hours the zinc becomes covered with a layer of zinc oxide, which, at some distance down the rod, spreads out and forms a kind of diaphragm, separating the liquid into two parts of different composition, the upper being strongly alkaline, and containing no zinc in solution, whilst the lower is neutral, and contains zinc chloride. Since the heat of formation of the zinc oxide is greater than that of water, the zinc decomposes the water; but the action is at once arrested by the formation of a superficial film of zinc oxide, insoluble both in water and in the sodium chloride solution. The decomposition of the sodium chloride solution by the zinc-platinum couple is also of an exothermic character, zinc chloride and sodium hydroxide being formed. In consequence of the latter solutions being lighter than the solution of sodium chloride, there is an upward current of sodium hydroxide solution along the surface of the platinum plate, and a downward current of zinc chloride solution from the zinc rod. Zinc hydroxide is formed by the inter-diffusion of these two currents.

If the platinum plate is replaced by a mass of manganese peroxide polarisation is greatly reduced, and the layer of liquid which the electric current has to traverse is also much thinner; consequently the action is more rapid and the phenomena are more marked. They are of the same order as those which are observed when a porous pot filled with the ordinary mixture of coke and manganese is employed. In the ordinary cell, moreover, the sodium hydroxide solution is retained in the porous pot, and no zinc oxide is formed in the outer liquid until the alkaline solution escapes.

When the zinc-platinum couple is immersed in a solution of ammonium chloride, not only is the solution decomposed and the zinc oxidised, but the zinc oxide is now able to act upon the alkaline chloride. This cell formed the subject of a further communication by Mons. Ditte to the Paris

Academy of Sciences (*vide Comptes Rendus*, cxvi., pp. 984—986.)

The following were the more important observations made :—At the ordinary temperature, the decomposition is more rapid the stronger the ammonium chloride solution. Hydrogen is evolved, and compounds are formed which contain zinc oxide and ammonia in proportions that depend on the concentration of the solution. Apart from secondary reactions, the decomposition of ammonium chloride by zinc is exothermic. No precipitate is formed, however, because the zinc oxide is soluble in ammonia solution ; but ammonia tends to accumulate in the upper part of the liquid, and zinc chloride in the lower layers. The electrical resistance is lessened and decomposition accelerated by substituting for the plate of platinum a porous cell containing a mixture of carbon and manganese peroxide. With a 10 per cent. solution of ammonium chloride a secondary product crystallises as soon as the solution is saturated ; and when only a small quantity remains zinc oxide separates and mixes with the crystals. If the original solution contain 15 per cent. ammonium chloride, the crystalline product is of somewhat different composition, and tends to separate at first in the upper part of the liquid. In the lower part there is very little free ammonia, and a double zinc-ammonium chloride forms which by reason of its greater specific gravity tends to remain at the bottom of the cell, and thus to accelerate the solvent action upon the lower part of the zinc.

These observations show that although the details of behaviour may vary slightly when the conditions of the cell are varied, yet the total effect is the same whether the couple be formed of zinc and platinum, zinc and a porous pot full of a mixture of carbon and manganese peroxide, or zinc and a mass of manganese peroxide ; and whether solutions of ammonium chloride, of different degrees of concentration, be employed.

CORRESPONDENCE.

The New (?) Incandescent Arc Lamp.

I observe in your journal, as well as in the other technical papers, a description of "An Improved Arc Light," which was described in a paper read at Chicago by Mr. Marks. I always think it rather hard to see a device brought out as new which has already been carried out by oneself. In 1882, the very same lamp there spoken of, I made and used, and only dropped the matter finding that there was no great advantage to be gained, compared with little troubles which followed the new arrangement. To avoid the difficulty of passing the carbons through a closed globe, I employed a Jablochkoff candle. The apparatus was made for me by Messrs. Baker, of Holborn, and finished off here, so that ample evidence exists of the facts I mention.

David L. Salomons.

Tunbridge Wells.

Expert Testimony.

In a note headed "Expert Testimony," you condemn me with characteristic vigour for having carried out some experiments on certain electropathic belts, and having made a report "without probably giving a thought to the resulting consequences of the same." The consequences you conceive to be that "we have the double harm done of the sale of a questionable (to say the least) appliance being helped forward, and of a sound institution being imperilled." It will doubtless gratify you to learn that the work of the Electrical Standardising, Testing and Training Institution has shown no signs of falling off since the experiments were made. Furthermore, inasmuch as the report appears to have fallen into your hands only within the last week or so, although it is dated January 30th, 1893, and was in print on the first day of the trial of *Tibbits v. Alabaster and others*, it cannot have been very widely circulated during the last seven months. It would obviously be unbecoming in me to express any opinion, even were I competent to do so, as to the curative properties of the electropathic belts in question. The report is merely a record of the results obtained from certain electrical measurements, and the conditions under which the experiments were carried out. An occasional departure from the ordinary rules of grammar I believe to be due to the printer ; but this is wholly immaterial, the real significance of the note lies in the responsibility which you desire to lay upon experts. You say "we do not doubt that the experiments and reports are perfectly genuine and unbiassed," but you complain that "it may be used to delude the public, whose reasoning powers on scientific matters are of the shallowest." Usually, when a man attaches his name to any statements, he is deemed answerable for such statements only. Not so, apparently, with the electrical expert—it is not enough that his statements are absolutely accurate—the ELECTRICAL REVIEW will hold him answerable for any document of which, without his knowledge, others may make them form a part. The utter impracticability of an expert guarding against making public a fact which may be used in a way he does not intend it should, is well illustrated by an advertisement which appeared in the daily papers at the time of the trial referred to above, to the effect that "Lord Kelvin, President of the Royal Society, has recently confirmed the theory that when the elements in the electropathic belts are properly connected, small continuous currents of electrtity are generated and enter the human body." The evidence, of which use was thus made, was published in the ELECTRICAL REVIEW of February 17th, 1893, but nobody, as far as I am aware, held the REVIEW responsible for the advertisement.

Supressio veri, suggestio falsi. Have you not overlooked this in your zeal ? A charlatan can always get a certain following from that portion of the public for whom you are anxious, by boldly admitting that his methods are denounced by recognised authorities ; if to the rôle of charlatan he can add that of martyr, the number of his disciples will increase vastly. The fact that a known expert has refused to examine any appliance, is attributed by the public, who need protection, to be due not to fear for his own reputation, but to fear of revealing some new truth that may interfere with a monopoly in which he is interested. An expert can best serve the public by unhesitatingly furnishing facts from which the teachers of the public, *i.e.*, the Press, can expose an imposture, not by standing aloof so as to allow some plausible ignoramus to send out a report containing the desired untruths.

Hugh Erat Harrison.

Faraday House, *September 11th*, 1893.

[We will only add to this letter what we unintentionally omitted to say in our leaderette, that Mr. Harrison should take immediate steps to have the pamphlets bearing his name suppressed.—EDS. ELEC. REV.]

NOTES.

Telegraph Accounts.—An estimate of the revenue and expenditure of the Post Office Telegraphs for the year ending March 31st, 1893, has just been issued from the Treasury as a Parliamentary paper. The total revenue is estimated at £2,528,423, and the total expenditure at £2,683,789. The percentage of total expenditure to total revenue is 106·14, and there is estimated a deficit in the net revenue of £155,366. The percentage of salaries, &c., to total revenue is 67·95. The estimated cost of telegraphic extension is £96,989, the actual cost for the year 1891-92 having been £156,383.

Private Experimental Rooms.—The Electrical Standardising Testing and Training Institution, Faraday House, Charing Cross Road, has set apart a number of private rooms with a supply of electric current, alternating or direct, water and gas, for those who desire to do experimental work. All ordinary measuring instruments can be borrowed, and, if desired, assistance is afforded. The renter of a private room is given the key, and no one is allowed to enter it without his permission. Having recently conducted experiments in one of these rooms for the purpose of making a report on some electrical apparatus, we can speak very highly of the facilities offered at an expense which must be considered as very moderate. Such an establishment is a real boon to professional men, who do not always possess either suitable premises or apparatus for work of an experimental nature.

Electricians Wanted in France.—It is said that there is a real difficulty in obtaining practical electricians in Paris. Our young men with a knowledge of French should pay attention to this.

Torquay Electric Lighting.—Procrastination is the motto of the Torquay Town Council in regard to the electric lighting question. An Electric Lighting Committee put forward a report which they had been instructed to draw up. The report showed that an electrical engineer (Mr. Trentham) who had been consulted, recommended the high pressure system; this gentleman further gave details as to the costs of the various systems. The committee, after consideration, recommended that Mr. Trentham's terms for preparing the necessary specifications, &c., should be ascertained, and that they otherwise prepare to carry out the scheme. The estimated cost of the works was £17,403, maintenance, £3,100, and annual revenue at 6d. per unit, £3,320. When the Council met, the whole thing was fully discussed, and it was ultimately resolved to postpone the matter for six months. The reason for this step is that the town is already burdened with a debt of £360,000.

Charterhouse Science and Art Schools and Literary Institution.—The winter session of this, one of the largest Science and Art schools in the United Kingdom, will commence on Saturday, September 23rd, 1893, under the presidency of the Rev. H. Swann, M.A. During the late session upwards of 1,300 students, mostly elementary teachers, availed themselves of the privileges afforded by this Institute, and of this number nearly 900 presented themselves for examination, and were successful in obtaining a large number of advanced certificates and also a fair number of honours awarded by the Science and Art Department of South Kensington. The grants earned by the students were far in excess of those of any previous year. Instruction of a practical character is given in most of the Sciences at a nominal fee; whilst in Art, at an equally low rate, students under the direction of many competent instructors can be advanced in their studies. Those who have leisure can attend the day classes in Art. Day classes will also be held to prepare for matriculation (London) those who desire to undergo the clerical, medical, legal, and other examinations. Students who aim at proficiency in chemistry (organic and inorganic) have the opportunity of working in a well-fitted laboratory, capable of accommodating 60 students. Aspirants for University honours can, at a small expense, be assisted in their studies. Classes for Microscopy, Latin, Greek, French and German, Shorthand, Typewriting, and Music, are taught by well qualified teachers. Full particulars of the classes may be obtained from C. Smith, organising secretary. Those interested in education will rejoice to learn that the work commenced by the Rev. William Rogers, M.A., now of St. Botolph, Bishopsgate, and ably continued by the late Rev. John Rogers, M.A. (formerly vice-chairman of the London School Board), is so vigorously continued by the present president.

A Free Testimonial.—However careful some of our daily contemporaries may be to prevent deprecatory comments getting into their columns regarding appliances vended by some of their best paying advertisers, it seems that the truth must out. Evidence of the usual nature regarding the worthlessness of the articles in question was once more given before a jury on Thursday last week, this time in a Coroner's Court, while the testimony was that of the dead. A young man working in the City, whose mind was evidently deranged, had taken the unfortunate and too common step of self-destruction. A few months ago the deceased, in the course of conversation with his brother, appeared very distressed in spirits and altogether upset, and complained that he was continually suffering from extreme depression. He had tried, he said, "electropathic belts and every nostrum under the sun," but none of them had had any improving effect. He seems to have been of a very worrying disposition, and undoubtedly his disappointment over his purchase of appliances which "speedily renew within us that vital energy, the loss of which is the first symptom of decay, and maintain the mind in a cheerful, buoyant state," added largely to his disheartened condition.

Lighting of Huyton-with-Roby.—The British Insulated Wire Company ask the assistance of the Local Board in obtaining a provisional order for this district. The matter has been adjourned.

Electric Lighting at the British Museum.—The new lighting arrangements for the reading desks at the British Museum are, we understand, an improvement which is much appreciated by visitors. Each desk in the large reading room is furnished with eight to ten lamps, the total number in the room being nearly two hundred. The lamps were publicly lighted for the first time on Wednesday last week. Let us hope they will give more satisfaction than the arc lamps formerly used for the general lighting, about which complaints were so numerous.

Condition of the Electrical Trade in America.—We cull the following from the New York *Electrical World*:—"The repeal of the unpopular purchase clause of the Sherman bill will, it is hoped, be the means of restoring confidence in the business world. Electrical manufacturers and dealers have stood the unusual and, to many, unlooked-for strain of financial depression much better than have those in some other lines of business. The failures—or the temporary suspending of payments—among electrical companies have, everything considered, been few, and in most cases the assets are greatly in excess of the liabilities."

Extensions in St. Pancras.—The St. Pancras Vestry, acting upon the advice of their electrical engineer, Prof. Robinson, have authorised extensions of their electric lighting installation by the addition of three 90-unit engines and dynamos, and three boilers, at the existing Regent's Park Station with another sub-station in Regent's Park Road. These extensions will enable a further 5,000 16-C.P. lamps installed to be served. The Vestry have also decided to construct a second electric lighting station in combination with a refuse destructor in King's Road, which will still further increase the electric lighting of the district.

Coast Communication.—Communication with Lighthouses and Lightships.—In the House of Commons last week Mr. Mundella stated that the work of connecting the Kentish Knock light-vessel with the shore by telephone is now in progress. Lundy Island has been connected. Either the Tuskar or Gunfleet light will be put in hand at once, and the Chancellor of the Exchequer has also authorised the connection of the Goodwin (North Sand Head) light-vessel. All the shore lighthouses recommended, except that at the Needles, which is now in hand, have been already telephonically connected with the land. The experiment of connecting the Fastnet lighthouse with Crookhaven by a non-continuous cable has not yet been carried out.

In the House of Commons, on Saturday last, Sir M. Hicks-Beach said he desired to ask the Secretary to the Treasury a question upon the Supplementary Estimate circulated that morning. On the Board of Trade vote on the previous night the question of telegraphic communication with lighthouses and lightships was discussed, and it was understood that a Supplementary Estimate would be taken for that purpose. That Supplementary Estimate was for £10,000, which, it appeared, was proposed to be added to the grant towards the Mercantile Marine Fund. Of course that might be only a matter of form, but he hoped it was not to be taken as an indication that the Government considered the cost of the telegraphic communication ought in any case to be a charge upon the Mercantile Marine Fund. That was not his intention, and he hoped it would not be done, except, of course, where the communication was desired for Board of Trade purposes. Sir J. Hibbert said the Supplementary Estimate was put in the form in which it now appeared for convenience of discussion. The £10,000 would be kept entirely separate from the Mercantile Marine Fund. Sir M. Hicks-Beach said it had really nothing whatever to do with that fund. Mr. Mundella admitted that that was so. The fund would not bear one farthing of the expense of the telegraphic communication. The Board of Trade intended to execute the work by degrees, and the Treasury would supply the money, for which the Board would account.

Congress of Canadian Electrical Men.—The Canadian Electrical Association opened a three days' convention on Tuesday last.

Stockton Lags Behind.—The Board of Trade have intimated that they will defer for a year the consideration of revoking the provisional order granted to the Corporation in 1890.

The Bradford Extensions.—The Electricity Committee have recommended the acceptance of Messrs. Siemens's tender for two miles of cable for the Extensions.

Electricity Supply and Sewage.—Monmouth wants new sewage arrangements, and the mayor suggests that the profit on electric light work would pay the expenses of a new sewage system.

The World's Fair Electrical Jury.—The jury appointed to decide upon the merit of the electrical exhibits is composed of 21 Americans, 2 Englishmen, 2 Germans, 1 Turk, and 1 Brazilian. The Englishmen are Profs. Forbes and Ayrton.

Bristol Electric Lighting.—The Bristol Electrical Committee met on Friday. The demand for private lighting being found to be greater than anticipated, it was arranged that an order should be given for 60 additional house boxes and terminals. Three assistant engineers and some other officials were appointed. There was a long letter read from the secretary to the Carpenters and Joiners' Society complaining that in connection with the electric lighting station, the carpenters employed were not paid the recognised rate of wages according to the Trades' Union standard. An interview with the committee was asked for, and it was decided that the request should be granted, the number of the deputation to be limited to seven. Mr. Hayes, the contractor, is to be given the opportunity of being present.

The Dispersion of Electricity by Daylight.—An article published by Mons. Bichat in the *Journal de Physique* for 1889, contained a *résumé* of all the observations made up to that time on the action of light in dispersing negative electricity. The subject was taken up in 1890 by Mons. Edouard Branly, whose paper, read before the Académie des Sciences on April 8th, was briefly noticed in the ELECTRICAL REVIEW. More recently attention has been given to it by MM. Elster and Geitel [*Journal de Physique*, 3rd series, Vol. i., p. 557], and there is a further contribution to our knowledge of the phenomena in the *Journal de Physique* for July, 1893. From these investigations it appears that when metallic bodies, bearing charges of electricity, are exposed to the action of daylight, the quantity diminishes. This is especially the case with aluminium, but it has also been observed in the case of brass, copper, zinc and cadmium. A polished surface appears to be an essential condition for this dispersion of electric charge by daylight.

The Resistance of Commercial Copper.—We note a useful paper by Mons. E. Meylan in *L'Electricien* on the electrical resistance of commercial copper. The writer calls attention to the difficulty uniformly experienced, at least in France, of obtaining pure copper in the form of sheet or strip. An examination of many samples from various sources revealed a considerable variation in the specific resistance, and this, as is well known, is indicative of variable "purity." The following are examples of his results:—

Sample.	Specific Resistance.
1	1·68 microhms at 0° C.
2	1·82 " "
3	2·75 " "
4	4·05 " "

The specific resistance of pure copper varies from 1·616 microhm to 1·653 microhm, according as it is annealed or hardened by rolling. Mons. Meylan emphasises the difficulties which might therefore arise in using inadvertently sample 3 or 4, for instance, as pure copper. He states *en passant* that commercial aluminium, unlike commercial copper, is of uniform composition and purity; its specific resistance varies from 3·16 microhms to 3·35 microhms, whilst that usually quoted for the pure metal is 2·945 microhms.

Glasgow Electric Lighting.—The Secretary for Scotland has sanctioned the borrowing of £100,000 for electric lighting purposes. The extensions will be proceeded with at once.

Edison and Electrical Experiments.—An American contemporary says that Edison has given up experimenting in electricity, and will henceforth devote himself to chemistry, metallurgy, and his metallic ore separator.

Electric Tramways in the Isle of Man.—After several experiments the electric tramway, which is ultimately to go to Laxey from Douglas, a distance of seven miles, has been opened as far as Crowdle Glen. The cars are said to work very smoothly and satisfactorily. Owing to the advanced state of the season, only one or two cars are at present being run.

The Cost of the Chicago Exhibition.—We have recently expressed doubts as to whether or not the exhibition will be able to pay expenses. Up to August 7th cost of construction and the administration had amounted to 23,867,752 dollars. Assuming the daily receipts from all sources to the close of the exhibition continue as at present, there will be a deficit of nearly £3,000,000.

Bath Electric Lighting.—The latest electric light report showed that during the fortnight eight lamps had been out for an aggregate of 6 hours 20 minutes, but that no one lamp had been out longer than 1 hour 45 minutes. The causes assigned were failure in lighting when the current was turned on, and burning out of the carbon before the proper time in the early morning.

The Cordite Scandal.—Mr. Campbell-Bannerman, in defending Sir F. Abel and Prof. Dewar against the charge brought against them by Mr. Hanbury, in the House of Commons on Monday, is reported to have said "they had not picked the brains of other men, as had been asserted, and they had not put money into their pockets by the invention so far as this country was concerned. They took out the patents for cordite, and assigned them to the Secretary of State; and when they took out patents for it abroad they did so at a time when anyone else might have taken the idea and done the same." We should be glad to learn by what course of reasoning Mr. Campbell-Bannerman arrives at the conclusion that anyone else might have patented the invention of these two gentlemen abroad? It is not for us to follow Mr. Hanbury into the question by what authority two members of the War Office Committee were enabled to take out foreign patents as private individuals, and to set up as inventors; but we do protest against Mr. Campbell-Bannerman's curious views of patent office routine. Inventors do not generally protect a good thing in England and then leave it open to others to do the same thing abroad. Perhaps Mr. Campbell-Bannerman will explain himself more clearly?

Fatal Electric Light Accident.—A very sad accident occurred on Tuesday evening last at a sub-station of the London Electric Supply Corporation, situated in Blackfriars Road, causing the instantaneous death of the man in charge, and very severe injuries to his assistant. At a quarter past six o'clock the man in charge switched the transformers on the two sides of the station into parallel. He had no sooner done this comfortably and got everything all right, when he somehow or other broke the main switch, and threw one side of the station out of commission altogether. He next sent his assistant (Ernest Meech, aged 20) to clean the gear, but had forgotten to remove one of the plugs. Consequently the entire 2,400 volts was sent back on to the low tension side of the transformers, and in cleaning the apparatus the assistant experienced a powerful shock. He immediately shouted for help, and Robert Ball, the linesman in charge, came up and attempted to help him out of his danger, accordingly receiving the full extent of the shock, and was instantaneously killed. This deplorable accident is the more to be regretted as Ball had been for six or seven years in the service of the Corporation, and two years in charge of the particular station at Blackfriars. Investigations on the part of the company prove that the accident was entirely the fault of the poor fellow in omitting to take out the plug.

Huddersfield Electric Lighting.—An "Aggrieved Ratepayer" writes to the *Huddersfield Chronicle* deploring the "waste of public money" that will be incurred through the present intention of the Town Council to light St. George's Square by electricity at an annual cost of about "£60 in excess of that of gas."

Telegraphic Communication with Zambesia.—A Reuter's telegram from Lisbon, on 13th inst., reads as follows:—"A contract will be signed to-morrow between the Government and the Zambesi Company for the laying of a submarine cable to establish telegraphic communication with Zambesia, and for the construction of land telegraph lines in that region."

Harrogate Electric Lighting.—At a meeting of the Town Council the other day a sub-committee reported that they had conferred with Mr. Wilkinson with reference to his appointment as electrical engineer to the Corporation, and had agreed with him as to the terms on which he should prepare and carry out the installation in accordance with his report previously made.

Explanation of the Ferranti Phenomenon.—The New York *Electrical Engineer* just to hand contains an abstract of a paper read before the Chicago Congress by Dr. J. Sahulka. Dr. Sahulka described the Ferranti phenomenon that was first observed in the Deptford central station, near London, when the primary of a step-up converter was connected with an alternating current generator, whilst the secondary was connected with a Ferranti concentric cable. In this case the ratio of transformation may be considerably increased. Dr. Sahulka proved that the cause of the Ferranti phenomenon is due to the magnetic leakage in the transformer, and the fact was also experimentally proved by him.

Post Office and the Telephone.—The Postmaster-General's annual report on the Post Office, issued on Wednesday, states that, as regards telephones, the Telegraph Act, 1892, authorises the loan of £1,000,000 sterling for the purchase of the trunk lines of the companies, and for the construction of a Government system to connect the business centres of the kingdom. The negotiations have been carried on with the companies for the purpose of arriving at an understanding as to the areas within which their operations are to be conducted. The department has proceeded with the erection of trunk lines between Leeds and Hull, London and Brighton, Swansea and Cardiff, Cardiff and Newport, Newcastle and Hexham, Newcastle and Morpeth, and Glasgow and Belfast. The trunk line between Glasgow and Belfast was opened for traffic in May. A main trunk line is at present under construction from London to Glasgow, passing through Nottingham, Sheffield and Leeds. Branch lines will be erected from Nottingham to Derby and Leicester, and from Leeds to Manchester and Liverpool. The entire system will consist of metallic circuits, and when completed will enable each of the towns to communicate direct with London, or with each other.

Discussion of Mr. Preece's Paper.—The New York *Electrical Engineer* publishes the following abstracted account of the discussion which took place on Mr. Preece's paper delivered before the Chicago Congress:—Mr. T. D. Lockwood opened the discussion. He described certain similar experiments made by Morse, Vail and Rogers, on the Susquehanna River, in which clear signals were received. The work of Mr. Deering, of London, in 1853, and of Mr. Lindsay, of Dundee, was also cited. He then spoke of the relations of trolley wires and telephone lines in America and in England. He doubted the conclusiveness of Mr. Preece's experiments, that the communication between the shore and the island was due wholly to electromagnetic induction. He did not think that the system would ever be of great commercial value. Mr. Heanich spoke of an experiment made by him in which telephonic speech was clearly heard between the surface of the ground and the bottom of the colliery pit 60 fathoms deep, by means of parallel wires. Dr. C. E. Emery told of telegraphing across streams during the war when lines were purposely cut to stop communication. In answer to a question, Mr. Preece stated that the shore wire was put 20 feet from the ground. Mr. Preece promised to pursue the subject and present the results at the next Congress.

Barrow and Electric Lighting.—The inhabitants are to be circularised, so as to ascertain the probable consumption of electric light in the event of its introduction.

A New Professor.—A Barrow daily states that a lecture on "Electric Light; its cost and utility in our homes," was delivered in the Town Hall there on 7th inst. by "*Prof. Hammond, M.J.E.E.*" !!

American Litigation.—Whatever the General Electric Company of New York may have been guilty of regarding blue prints belonging to competitive concerns, if the statements in the American journals just to hand are correct, the company appear to have strange convictions as to what is fair dealing. The Western Electric Company has entered a claim against the General Electric, and certain of their *employés*, for $10,000 damages for removing certain advertising signs from electric light poles in the Electricity Buildings of the World's Fair. The Western Company, under special agreement, erected 30 arc light poles, and as a consideration for furnishing the poles, were to be allowed to place a small brass plate near the base of each pole, and also on the glass signs inserted in the hood or covering at the top, with the understanding that in the case of lamps furnished by other manufacturers than themselves, these should be marked with the names of such companies, thus giving to them due credit for their lamps, and to the Western Electric Company credit for their poles. Twenty-seven of these poles were furnished with arc lamps by the General Electric Company, who vainly endeavoured to have the glass signs removed. This permission was refused by the Exhibition authorities. Thereupon the General Electric, on the night of July 17th, between the hours of 11 p.m. and 2 a.m., sent five of their *employés* to unlawfully remove the signs. All attempts to gain possession of these signs since by the complainants have been fruitless, and the five men have been induced by the General Electric Company to abscond.

Lightning.—Our contemporary, in its last issue, referring to our note *re* Mr. H. E. Harrison, has missed an important point in its good natured criticisms. The simple fact of experiments being made was not objected to, but what was condemned was that such experiments should have been made on the invitation of the proprietor of the appliances, when it should have been obvious (so we think) that a questionable use might be made of the same. As regards Mr. Preece's Chicago paper, we must assert again that the substance of the same *is* new; a small portion of the paper, it is true, relates to published experiments made over a year ago on the South Wales coast; but this was merely introductory to what has never been published, seeing that the experiments with which the paper chiefly deals were made only a few weeks before they appeared in the paper in question.

We are pleased to see that an esteemed friend of ours, Mr. A. Dearlove, has obtained the degree of "Dr."; we thought, however, that the sole power of conferring honours possessed by the Press was confined to *Ally Sloper's Half-Holiday*.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ecuador Telephone Company, Limited.—The annual return of this company was filed on the 8th inst., and shows that out of a capital of £100,000, in £5 shares, 5,000 shares have been taken up, with the full amount called on each. The total amount received is £25,000.

BUSINESS NOTICES, &c.

J. A. Berly's Universal Electrical Directory for 1893 (12th year), 784 pp. This standard work, now under the direct supervision of the proprietors, H. Alabaster, Gatehouse and Co., contains a larger amount of trade information than any other similar publication, and should be in the hands of every engineer and electrician. Free within the Postal Union for 4s.

Montrose and the Electric Light.—Some time ago Mr. Strachan brought up at Montrose Police Commission the question of lighting the town by electricity. The matter was remitted to a committee, who asked Mr. W. A. Bryson, consulting electrical engineer, of Glasgow, to report on the subject. His report has now been presented. We abstract the following from it:—"Any scheme to utilise the water of the North Esk for electric light purposes may at once be abandoned, as owing to the level character of the district no sufficient head is obtainable. To utilise the power of the tide race at the Suspension Bridge is somewhat more feasible, but there are so many engineering difficulties and electrical considerations to be taken into account that in my opinion the cost of installing the necessary double pontoons, water-wheels, multiplying gear, dynamos, storage cells, &c., would be prohibitive. . . . I consider that no account can be taken of the useful effect during the flood. Assuming that the total requirements of the burgh as regards electric lighting amounted to 1,000 lamps of 16-candle or 2,000 lamps of 8-candle, this would represent 125 H.P. To gain this I consider that at least five double pontoons would be required, each set containing the generating and storage plant. For the foregoing reasons I am strongly of the opinion that it would neither be satisfactory nor economical to adopt water as the source of motive power. I would, therefore, suggest for your further consideration the laying down of a small lighting station with steam engines and boilers, or, preferably, gas engines and producers. To instal a small generating station on a site to be chosen near the centre of the burgh and as near a railway siding as possible would cost about £6,000. If a large battery of accumulators be added the cost will be increased by £2,000. Allowing 10 per cent. depreciation on the moving machinery and boilers, and interest on capital at 4 per cent., the charges would be £730. Estimated annual cost of maintenance for 2,000 lamps installed on a basis of a 24 hour service and a load factor of 15 per cent. of the possible maximum, £2,299; working expenses, £1,947; credit balance, £352; but this favourable result is on the assumption that out of 2,000 lamps installed the amount consumed by householders would be equal to 300 lamps always in use. The price taken per Board of Trade unit—viz. 6d.—is equivalent to gas at 5s. per 1,000 feet. I am of opinion that with a carefully designed station, where the mains have been laid to meet requirements obtained by a house-to-house canvas, and the motive power is obtained from large gas engines driven by produce gas, the cost of generating the current will not exceed 2d. per unit. I will have reliable data in my possession within the next two or three months, when the Coatbridge station is completed, which has been designed on the above lines." The Board has deferred further consideration until the additional information is at hand.

Mill Lighting.—The Wray Electrical Engineering Company, of Soho Works, Thornton Road, Bradford, have secured the contract for the erection of a complete electric light plant at the extensive cotton mills of Messrs. E. Heyworth & Son, Audley Hall Mills, Blackburn. The installation will consist of about 750 lamps of 16 candle-power, with separate slow speed vertical engine supplied by Robey & Co., Globe Works, Lincoln, and specially designed in combination with a direct driven dynamo for this installation. The firm are also engaged on the wiring and fitting of the Mersey Rice and Flour Mill, Liverpool, owned by Mr. Edward Hutchinson. This will be one of the largest electric light installations in corn mills in the north, and will consist of two 400-light dynamos and storage for 400 lights, together with a separate engine and dynamo for lighting the mill in the daytime. The Wray Electrical Engineering Company have recently completed a similar installation at Messrs. H. Leetham & Sons, Hungate Flour Mills, York. The company are very busy, being engaged on the wiring and fitting of the following premises: Messrs. Pattinson & Winter, corn millers, Whitehaven; Messrs. Nicholson & Birkett, Kirton-Lindsey, Gainsboro'; Messrs. Goodall's Drug Company, Morley; Messrs. Robinson Bros., Town Corn Mills, Rotherham; Messrs. J. Wigfull & Sons, Star Corn Mills, Sheffield.

Messrs. Wright, Pennel & Co., of Selkirk, are having an electric installation put down in their mills, which has one novel feature, in that the spinning sheds are lighted by small arc lamps of 4 to 6 ampères each, thus securing an immeasurably superior light to that of incandescent lamps. The whole work is being carried out by Messrs. R. Murray & Son, Glasgow, who make a speciality of lighting by small arc lamps which are manufactured in Belgium.

The Electric Light at Norwich.—The use of the electric light in Norwich is said to be increasing very rapidly. The business premises of many of the principal firms in the city are already illuminated by electricity, and now the use of the light is being extended to places of worship and other public buildings. The United Methodist Free Church in Chapel Field Road is the first place of worship in the city that has been lit up by the Electricity Company. The installation has been carried out most satisfactorily by Messrs. Laurence, Scott & Co. The chapel itself is fitted with 46 16-candle-power incandescent lamps and 18 32-candle-power incandescent lamps in clusters of three. In the organ chamber there are two brackets, each with a lamp of 16-candle power, and the organ manuals have two lights of like power fitted with reflectors. In the porch there is a very elegant elecirolier. In the various class rooms at the rear of the chapel there are 12 16-candle lamps. The lights were used for the first time last Sunday.

African Trans-Continental Telegraph Company.—Dalziel's Lisbon correspondent telegraphs to the *Financial Times* as follows: "The question of the African Trans-continental Telegraph Company continues to seriously pre-occupy the press. All official *dementi* notwithstanding, I am in a position to again affirm that a contract was recently signed in London between the company and a certain Portuguese official, subject to the approval of the Portuguese Government. A leading member of the Government has since assured me that the Government will not approve the contract."

International Electric Syndicate.—This company was formed in April, 1891, to acquire patents and improvements in the construction of electric accumulators, and generally to carry on the business of electrical machinery manufacturers. The nominal capital was £12,000, divided into £10 shares, but only 807 were allotted, and of that number 800 were issued to the vendors as fully paid. The promotor of the company is stated to have been Mr. R. W. Davey, who was adjudicated bankrupt in December, 1892, and has not yet surrendered. The letters patent cannot be traced amongst the papers of the company, nor has it been possible to ascertain in whose possession they were in November last when the winding up order was made. No statement of affairs has yet been filed, owing to the fact that the only officers of the company who appear to be able to file the same, have left the country, and there is no immediate prospect of their return.

Under the liquidation of the International Electric Syndicate, meetings of the creditors and shareholders were held on Wednesday before Mr. A. S. Cully, Assistant-Receiver. The Chairman stated that the company was formed in April, 1891, the promoter being Mr. Robert Williams Davey, against whom bankruptcy proceedings were instituted last December. That gentleman had absconded, and the only information obtained by the Official Receiver had been furnished by certain of the signatories. The Official Receiver had been granted access to certain books and papers which showed that there had been a considerable amount of fraud in relation to the company. All attempts to trace either Mr. Davey or the patents had been futile. A question would arise as to the real ownership of the patents, as one of the vendors had repudiated the shares allotted in consideration of the transfer, and claimed a return of the patents. In the absence of Mr. Davey nothing could be done, and the case was left in the hands of the Official Receiver to be wound up in the usual manner.

Catalogues.—Mr. Robert W. Blackwell, of Westminster, has lately published a price list (September, 1893) of Anderson line material, and special appliances for electric tramways. A number of insulators of various types are very plainly described and clearly illustrated by small blocks. The "Boston" trolley pole and wheel are also fully detailed, the accessorial parts being separately illustrated and priced. The "Pivotal Boston" trolley wheel, the "Ajax" lightning arrester, stretching machines, bending machines, arc lamp hangers, and many appurtenances for electric railways and tramways, as manufactured by Messrs. Albert and J. M. Anderson, of Boston, Mass., are dealt with. At the end of the book is a telegraph code which should be of much service to customers. The pamphlet is got up in exceedingly neat style and clearly printed. We have pleasure in recommending it to those interested in this special branch of the industry.

Messrs. Hartmann & Braun, of Bockenheim-Frankfort, have forwarded us a copy of their 1893 catalogue of electrical apparatus. Voltmeters, ammeters, pyrometers, galvanometers, and similar instruments are very fully particularised and well illustrated. The book is printed in German.

Chimatto Enamel.—Messrs. Fletcher, Russell & Co., of Warrington, have lately commenced the manufacture and sale of a new enamel, which they have applied to gas and other apparatus. We have received a small gas boiling burner of cast-iron, the surface of which has been treated by this new process, which is said to entirely prevent rust, whilst as regards decorative effect, the capabilities are numerous. All colours, the most delicate tints in any number, either dead or bright, and both gold and silver, also either dull or polished, are obtainable on the same casting, and all alike are unchangeable, either with exposure to air, or to any heat up to a bright red. The film of enamel is so thin, that the most microscopic details on the metal are unchanged. The application is new, and admits of a large extension for permanent decorative work of all kinds. Castings protected in this manner are not only capable of fine artistic treatment, but they are also claimed to be absolutely permanent, and proof against dirt and smoke, which disfigure other work so rapidly.

Telegrams to South America.—The managing director of the Western and Brazilian Telegraph Company writes us with reference to telegraphic communication with South America, stating that the route of this company is completely open, so far as messages to the River Plate are concerned. The notification of the Brazilian Government only refers to traffic affecting Brazil, transit messages to Montevideo, Buenos Ayres, &c., not being interfered with.

Mr. E. W. Parsoné, Secretary of the South American Cable Company, Limited, has written to the *Times* to the following effect: "As the telegrams referring to the Revolution in Brazil, published in your issue of 8th inst., imply that telegraphic communication with Montevideo and the Argentine Republic is confined to one route and subject to delay, we think it may be of public interest to state that a message despatched on the 7th inst. to Buenos Ayres, *vid* Eastern Noronha, arrived at its destination within four hours, and a reply was received the same day, occupying 40 minutes in transmission."

The British Insulated Wire Company.—At a recent meeting or the Southport Town Council, the sub-committee on electric lighting recommended that the tender of the British Insulated Wire Company, Limited, to supply 5,504 yards of high tension cables for £2,080 be accepted. This estimate was not the lowest for the high tension cables, but the committee decided that they would give the contract to that firm. There were three other firms lower, so that they were not buying in the cheapest market. Their engineer, however, recommended that firm, although each of the others had complied with the conditions of the specifications.

Exhibitions.—From November 6th to December 2nd, there is to be held in St. George's Drill Hall, Newcastle, an Industrial, Electrical, Manufacturers, and General Trades Exhibition. The hall will be ready for the reception of goods on November 2nd, though arrangements may possibly be made for earlier delivery if absolutely necessary. Diplomas for gold, silver, and bronze medals are to be awarded to such exhibitors in each section as may be deemed entitled thereto. The sections will include engineering, mining, metallurgy, recent inventions of numerous descriptions, constructions, sanitation and ventilation, decoration, hardware, furniture, gas, electricity, horticulture, smoke abatement, arts, sciences, &c.

The exhibition at Bournemouth closed on Wednesday, and that at Poole opens on 18th inst.

Abell's Electrical Engineering Company, Limited.—At extraordinary general meetings of this company, held at the registered office, Raglan Street, St. Helens, Lancs., on August 14th and September 1st, 1893, the following special resolutions were passed:—"That the company be wound up voluntarily under the provisions in that behalf of the Companies' Acts, 1862 and 1867; and that Frederick William Marsh, of Liverpool and St. Helens, chartered accountant, be and he is appointed liquidator for the purpose of winding up the affairs of the company."

Electric Light at Glasgow.—A correspondent of the *Glasgow Herald* writes as follows:—"To those who require to traverse Kelvingrove Park in the evening, the meagreness and inadequacy of gas as an illuminant for open space must be apparent. To light the thoroughfares of the park the electric arc light would be most effective, and could only be objected to on the score of cost. But it seems to me that the water power of the Kelvin could be utilised easily to illuminate not the park only, but also the College and Art Galleries."

Morley Council Want Tenders.—The Town Council have resolved, on the recommendation of the Electric Lighting Committee, to advertise for schemes to be submitted for the electric lighting of the Town Hall and the borough generally, the competitors to show in detail two schemes—one for the lighting of the Town Hall, and the other for the lighting of such parts of the borough as the competitors think a supply of electric light could be profitably given to.

Holborn Board of Works.—*London* says that the Holborn Board of Works is one of the bodies which leads the way in electric lighting. We were always of opinion that it was a body having considerable resistance, considering that they have in the past strenuously opposed electric lighting. However, they have now repented of their errors, and Messrs. Verity have been allowed to fit up over 200 lamps in the hall of the board.

The City Private Supply.—The *City Press* for Saturday last contained a long general article on the electric light in the city. The remarks bear more especially upon the private supply.

A communication from the City of London Electric Lighting Company to the city authorities, states that the current will be supplied to Newgate Street at about the end of the present month.

Electric Light at Bandon.—We stated some weeks ago that Bandon was in County Cork, and that the authorities were considering the introduction of the electric light. Bandon is still in County Cork, but the authorities have decided not to undertake the lighting themselves, and they will prevent anybody else doing it. Home Rule for Ould Oireland!

Business Announcement.—Messrs. Dorman & Smith, of Manchester, inform us that their agreement with Mr. H. R. Wood, who has lately represented them in London, having terminated, Mr. A. H. Dorman has undertaken entire charge of the London department, at the same address as formerly, *i.e.*, 11, Grocer's Hall Court, Poultry, E.C.

Consolidated Telephone Construction and Maintenance Company, Limited.—The *London Gazette* publishes official notification to the effect that the final legal duties in connection with the reduction of the capital have been carried out. The figures of the reduction were given in our columns some months ago.

Refuse Destructors and Electric Lighting.—At a recent meeting of the Harrogate Town Council, a letter was read from Mr. Priestley, of Halifax, as to a refuse destructor to be used in the raising of steam in connection with the electric lighting installation. The letter was referred to the General Purposes Committee.

Aberystwyth and the Electric Light.—The Town Council have decided that the opening and consideration of tenders for the transfer by the Corporation of their powers, duties, liabilities and works, under their provisional order, shall be referred to a committee of the whole council to report to a special meeting.

Wolverhampton Electric Lighting.—At last Monday's meeting of the Town Council a communication was received from the Local Government Board giving formal sanction for the borrowing of £1,928 for the purchase of land for the purposes of electric lighting.

Perth Electric Lighting.—The Town Council have refused their consent to an application by the Caledonian Electric Supply Company, Limited, to the Board of Trade for a provisional order authorising them to supply electric light to the borough.

Provisional Order.—At a recent meeting of the Swinton and Pendlebury Local Board, the advisability of the board seeking a provisional order to light the district with the electric light was referred to a committee of the whole Board.

Personal.—Mr. George Driver, 210, Euston Road, N.W., has been appointed agent for the sale of the ornamental wood casings manufactured by the Wood Carving Company, of Birmingham, which were referred to in a recent issue.

Warminster Electric Lighting.—At last week's meeting of the Local Board, it was stated that something definite regarding the introduction of the electric light would be brought forward at the next meeting.

Plymouth Town Hall Electric Lighting.—It is proposed to place the contract for lighting the interior of the Town Hall by electricity with Messrs. Veale & Co. for about £508.

Fleetwood Electric Lighting.—The commissioners are considering the estimates of electrical firms, and may be expected to make arrangements in a day or two.

Commercial Cable Company, Limited.—A quarterly dividend of 1¾ per cent. has been declared, payable on the 2nd proximo.

Derby Electric Lighting.—For the purpose of fitting up the Art Gallery with the electric light, £109 5s. 4d. is to be expended.

Bury Wants an Engineer.—The Town Council have resolved to advertise for an electrical engineer.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bristol.—September 21st. The Guardians of Bristol Incorporation invite tenders for an electric light installation for certain portions of St. Peter's Hospital, in accordance with a specification which can be seen on application to Mr. J. J. Simpson, clerk, St. Peter's Hospital, Bristol.

CLOSED.

Brighton.—At a meeting on September 1st, the Science and Art School Committee considered 11 tenders ranging from £570 to £370 10s., and resolved that the tender of Messrs. Fowler, Lancaster & Co., Limited, Birmingham, to supply and erect the necessary fittings for lighting the Municipal School of Science and Art for the sum of £370 10s., should be accepted, subject to the sureties to be proposed by them for the due performance of the work being approved of by the Committee.

Ealing.—The following is a list of the tenders submitted for wiring the public buildings:—

	£	s.	d.
Binko & Co.	684	18	6
Brown & Co.	700	0	0
Spagnoletti & Co.	793	0	0
Paterson & Cooper (accepted)	795	16	2
Taylor, Smith & Co.	842	0	0
Emanuell & Sons	853	15	0
Lund Brothers	871	4	6
Howard & Co.	875	18	0
R. A. Scott	903	0	0
The Brush Company	920	11	9
Phipps & Co.	990	0	0
Rawlings Brothers	1,020	7	0
Johnson & Phillips	1,099	9	0
The British Electric Company	1,119	0	0
Nicholson & Tyler	1,125	10	4
Thomas Digby	1,130	0	0
Sax & Co.	1,149	18	9
Baily & Grundy	1.188	0	0
MacClellan & Co.	1,249	12	3
R. Dawson	1,252	0	0
Crompton & Co.	1,259	0	0
Strode & Co.	1,277	15	3
S. Cutler & Sons	1,362	0	0
B. Verity & Sons	1,376	6	6
W. Mackie	1,611	5	3
Tickner	2,187	5	6

If the work can be well executed by Messrs. Paterson & Cooper for £796, how is it that some of the tenders sent in amount to double or nearly treble that amount?

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending September 10th, 1893, amounted to £751; week ending September 11th, 1892, £708; decrease £17; total receipts for half-year, 1893, £8,124; corresponding period, 1892, £7,695; increase £429.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending September 8th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £1,919.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation, September 6th.	Closing Quotation September 13th.	Business done during week ended September 13th, 1893. Highest.	Lowest.
184,500*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 –102	99 –102	...	...
1,134,640*l*	Anglo-American Telegraph, Limited	Stock	50½ – 51½	50 – 51	50½	...
2,932,680*l*	Do. do. 6 p. c. Preferred	Stock	92½ – 93½	92½ – 93½	93½	92½
2,932,680*l*	Do. do. Deferred	Stock	9⅝ – 10½	9⅝ – 10½	10½	10
130,000	Brazilian Submarine Telegraph, Limited	10	11½ – 12½	11½ – 12	12	11⅝
18,700*l*	Do. do. 5 p. c. Bonds	100	99 –103	99 –103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	107 –111	107 –111	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅞ – 3½ xd	2⅞ – 3½	3½	2⅞
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2 – 2½ xd	2⅛ – 2⅜	2 5/16	2⅛
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	105 –107 xd	106 –108	...	...
20,510	Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000	5	5 – 5½	5 – 5½	...	...
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	2 – 3	2 – 3	...	...
630,000*l*	City and South London Railway	Stock	35 – 37	35 – 37	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	11 – 11½	11¼ – 11⅝	...	...
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	12½ – 13½	12½ – 13	12 1/16	12⅝
$7,716,000	Commercial Cable, Capital Stock	$100	127 –132	127 –132	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	10/-	1/16 – 1/16	1/16 – 1/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	4 – 5	3½ – 4½	...	...
50,000*l*	Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	98 –102	98 –102	...	...
16,000	Cuba Telegraph, Limited	10	11 – 12 xd	11 – 12	...	...
6,000	Do. do. 10 p. c. Preference	10	18 – 19 xd	18 – 19	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ – 3½	2½ – 3½	3⅛	3 1/16
6,000	Do. do. 10 p. c. Preference	5	8½ – 9½	8½ – 9½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11½ – 11⅝	11½ – 11⅝	11⅝	11⅝
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	15 – 15½	15 – 15½	15 3/16	15
70,000	Do. 6 p. c. Preference	10	16 – 16½	16 – 16½	16⅜	16 1/16
105,900*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	106 –109	106 –109	...	...
1,294,100*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	111 –114	111 –114	113½	111½
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅛ – 15⅜	15⅛ – 15⅜	15⅜	15¼
62,700*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 –105	102 –105	...	...
222,800*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 –105	102 –105	102½	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	110 –113	110 –113	110	...
108,700*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	100 –103	100 –103	103⅜	...
146,800*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 –104	101 –104	102½	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	100 –103	100 –103	103¼	101
200,000*l*	Do. 4 p. c. Reg. Mt. Debs. (Mauritius Subsidy) 1 to 8,000	25	102 –105 °/o	103 –106 °/o	104¼	...
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	1½ – 1⅝	1½ – 1⅝	1⅝	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/16 – 1/8	1/16 – 1/8	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	1/16 – 1/8	1/16 – 1/8	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1/16 – 1/8	1/16 – 1/8	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1 – 2	1 – 2	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅝ – 9¾	9⅝ – 9¾	9¾	9 11/16
180,042	Do. do. 6 p. c. Preference	10	15½ – 15⅝	15½ – 15½	15½	15¼
150,000	Great Northern Tel. Company of Copenhagen	10	19¾ – 20¼	19¾ – 20¼	20⅛	...
200,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	103 –106 xd	103 –106	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ – 5½	4½ – 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6 – 7	6 – 7	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½ – 22½	21½ – 22½	22½	22
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 –104	102 –104	102½	...
17,000	Indo-European Telegraph, Limited	25	39 – 42	39 – 42	39½	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	1 – 2	1 – 2	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4 5/16 – 4 7/16	4½ – 4½ xd	4 7/16	4 1/16
10,000	Do. do. fully paid	5	6½ – 6¾	6 – 6½ xd	6¾	5¾
37,548	London Platino-Brazilian Telegraph, Limited	10	4 – 6	4 – 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	104 –107 xd	104 –107	...	..
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½ – 6⅝	6½ – 7	6⅝	6⅝
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 –105	104 –107	105½	105
15,000	Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ...	5	1½ – 2½	1½ – 2½	...	...
28,000	Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid	5	3 – 4	3 – 4	...	...
458,867	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜ – 4⅝	4⅜ – 4⅝	4 9/16	4½
15,000	Do. 6 p. c. Cum., 1st Preference	10	14½ – 15½	14½ – 15½	14½	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	14 – 15	14 – 15	14	...
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5¼ – 5½	5¼ – 5½	...	...
726,427*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	111 –113	111 –113	113	111½
48,800	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,452	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 – 6	5 – 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16 – 5/16 xd	3/16 – 5/16	...	...
100,000*l*	Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000	100	100 –103	100 –103	102½	...
11,802	Reuter's Limited	8	4½ – 5½	4½ – 5½	...	...
19,980	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	6¼ – 6⅝	6½ – 7	6⅝	6 7/16
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 – 8⅛	8 – 8⅛	...	...
3,381	Submarine Cables Trust	Cert.	115 –120	115 –120	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	1⅝ – 2¼	2 – 2¼	2⅛	...
37,350	Telegraph Construction and Maintenance, Limited	12	32 – 34	32 – 34	33½	33
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 –104	101 –104	...	...
58,000	United River Plate Telephone, Limited	5	2 – 2½	2 – 2½	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 – 100	90 –100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½ – 6½	5½ – 6½	...	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	97 –100 xd	97 –100	...	...
30,000	West Coast of America Telegraph, Limited	10	2 – 3	2 – 3	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	97 –101	97 –101	...	...
64,242	Western and Brazilian Telegraph, Limited	15	6½ – 7	6¼ – 7	6⅝	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5⅝ – 6¼	5⅝ – 6¼	5⅝	...
33,129	Do. do. do. 5 p. c. Deferred	7½	1¼ – 1⅝	1¼ – 1⅝	...	...
178,200*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 –106	103 –106	105½	103¼
222,700*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 –106	103 –106	...	..
88,321	West India and Panama Telegraph, Limited	10	1⅛ – 1⅜	1¼ – 1⅜	...	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10¼ – 10⅝	10¼ – 10⅝	...	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 –10	9 – 10	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	106 –109	106 –109	108½	...
$1,214,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 –125	115 –120	...	...
169,000*l*	Do. do. 6 p. c. Sterling Bonds	100	100 –103 xd	101 –104	...	...
69,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	4⅜ – 5½	4⅜ – 5½	5 1/16	4⅞

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5½—6.—Electric and General Investment, shares of £5 (£1 paid), 1⅞—2⅛.—Founders' shares, 200—225.—House to House Company (£5 paid) 1½—2½.—Do. 7 per cent. Preference of £5, 5—5¼.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5¼—5⅝, 1st Preference Cumulative 6 per cent., £5 (fully paid) 6—6¼.—Manchester, Edison and Swan Company £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating 6 per cent. £10 Debentures, 191—193.

Bank rate of discount, 5 per cent. (August

ELECTRIC LIGHTING OF SAÕ CARLOS DO PINHAL.

[FROM A CORRESPONDENT.]

THIS is the first town in Brazil (or at any rate in the State of Sao Paulo), dependent entirely upon electricity for its public and private lighting; for this reason some information in connection with it may prove interesting.

The motive power for the installation is obtained from a waterfall called "Monjollinho," distant 2½ miles from the town. There is a vertical fall of 123 feet, with sufficient water in the dry season to furnish over 1,000 H.P.

At present, two 18-inch turbines (by Hett, of Brigg) are placed, each capable of producing 100 H.P. They are connected direct on to two Mordey-Victoria 37,500 watt alternators, which are excited by two Victoria compound-wound exciters, each of which is capable of exciting both alternators. The turbines are furnished with delicate automatic regulators, and from each main shaft is driven a tachometer.

Each alternator and exciter is furnished with a Brush standard switchboard, with testing and regulating apparatus complete, which are joined up with a circuit, and a synchroniser board for parallel working.

On the main line is connected a Shallenberger meter, lightning protectors, and a Westinghouse "ground" detector.

From the waterfall to the town, 7/14 strand cable, covered with vulcanised rubber and braided, is employed, while inside the town limits 7/14 strand Callender's bitite Board of Trade 1/10-inch insulation, 600 megohms insulation resistance, is used. This latter is suspended by porcelain hooks from a three-strand No. 14 B.W.G. steel wire.

The main high-tension cables run straight through the town, and from them branch off on either side cables of No. 12 B.W.G. solid copper wire heavily insulated.

A complete network, consisting of 17 miles No. 10 B.W.G. heavily insulated cable, is run through all the streets. The whole of this is joined up in parallel, and connected to it at various points (according to the greater or less demands for current), are the secondary coils of 28 1,500-watt Mordey-Victoria transformers, which reduce the tension of the 2,000 volt primary mains, to the 100 volt tension of this low tension network.

The transformers are enclosed in cast-iron cases which are bolted to the posts. They are not at all unsightly, and this method of placing them is exceedingly convenient.

Each transformer is fitted with high and low tension fuses. The low tension fuses are placed in a small separate box with a glass front, and are most necessary, for without them a transformer which had blown out its primary fuse would have its secondary worked back upon by all the remaining transformers in the town, resulting in a heavy drop in E.M.F. over the whole circuit, and the complete charring up of the faulty transformer. This occurred once during a trial before the secondary fuses had arrived. The glass front enables a faulty transformer to be found at once. In fact the cast-iron cases should be fitted with a glass plate in front of the terminals and fuses.

All insulators are of the oil type, and are fitted with wire guards.

At each junction of branches with the mains are placed double-pole switches, cut-outs, and lightning protectors. Every post is earth-wired, the wire being carried 6 inches above the roof to serve as a lightning conductor.

The public illumination consists at the present time of 220 16-C.P. incandescent lamps enclosed in a clear 8 inch glass globe and covered with an enamelled iron shade. The lamps are from 30 to 40 yards apart, and 12 feet above the street. The illumination is not of course brilliant, but is perfectly satisfactory, and every lamp, up to the most distant points, is fully incandesced, the light (as the local journals describe it) being equal to a good moonlight. The theatre, billiard rooms, club, and many private houses are already fitted.

Many 32 C.P. lamps are in use, and one 400 C.P. Sunbeam. Four Brockie-Pell arc lamps have been run perfectly on the town circuit. The inhabitants are immensely pleased and the daily papers have been profuse in their praises of the engineers who carried out the work.

The public lighting was officially handed over to the town authorities on July 1st, 1893, since when it has been maintained from 6 p.m. to 5 a.m. every night without a single hitch.

Orders have been sent to England for material to double the present output, but, since sending these, applications have been received for many more lamps than can be supplied even with the new plant.

As the electric light is supplied for less than the cost of kerosene, it is natural to suppose that not a hut in the town will be without its electric lamp.

EXPERIMENT SHOWING MAGNETIC LAG.

MOST students of electricity know, theoretically, what is meant by magnetic retardation, or magnetic lag, and electrical engineers and manufacturers of electrical machines understand the causes and effects of this action in the armatures of dynamos and motors; but to most people, and especially to students who really desire to fix an idea in their minds, an experimental demonstration is more valuable than any amount of theory.

It is, of course, impossible to see what goes on in an armature while moving, but it is known that the armature core becomes a magnet by induction, and that its poles are of the opposite name to the adjoining poles of the field magnet. It is also known that time is required for the magnetisation and demagnetisation of the armature. The time element is thus seen to be one which cannot be left out of the calculation in designing dynamo-electric machines.

A very simple experiment, described by Geo. M. Hopkins in the *Scientific American*, and which helps to an understanding of what magnetic lag is, is shown in the annexed engraving. A perforated block is inserted between the polar

extremities of a U-magnet to receive a pointed spindle attached to a soft iron disc held near the poles of the magnet. The pointed end of the spindle rests upon a cross bar inserted between the arms of the magnet. The disc, which turns very freely, absorbs the magnetic lines, and becomes strongly magnetic. When the disc is at rest, poles are developed in the disc in front of the poles of the magnet; but when the disc is turned ever so little, the poles in the disc are carried forward in the direction of rotation. This is proved by the action of the disc when it stops. It immediately moves a short distance in a retrograde direction, showing that the points of greatest magnetic density in the disc lie beyond the poles of the magnet in the direction of the rotation of the disc, and that these points are attracted

toward the magnet poles. Owing to the friction of the bearings of the spindle, and to the almost immediate re-adjustment of the magnetic lines in the material of the disc, the return movement does not represent the entire lag, but it shows in a striking manner what lag is.

A NEW STARTER FOR GAS AND OIL ENGINES.

WE illustrate below a new apparatus lately placed upon the market by Messrs. G. Lewis & Sons, of Kettering, for starting, by hand power, gas and oil engines. The ordinary method of starting gas engines by the fly-wheel is not only laborious but sometimes dangerous.

The device which has been patented by Mr. T. Lewis is said to entirely prevent this, and the engine is started with comparative ease and perfect safety, the grippers are instantaneous in action and automatic in their release the moment the explosion takes place, and it is easily withdrawn by the hand after the engine is started. The grip takes place in

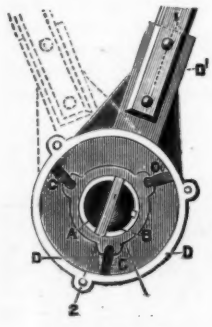


FIG. 1.

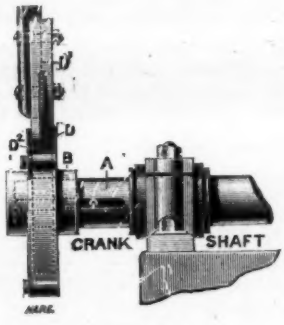


FIG. 2.

the pawl box and not on the shaft. Fig. 1 represents the starter with cover removed to show construction of clutches. Fig. 2 is a view of starter shown on crank shaft of engine to be started. In order to start the engine it is only necessary to rock the hand lever a few times from the drawn to the dotted lines as shown.

The apparatus is made on the principle, now so widely used in practical mechanics, of the automatic frictional wedge grip and corresponding automatic release. The grippers, C, are of the nearly radial type, acting within the box or case, D,

at the end of the lever, and on a short sleeve, which is put on the end of the engine shaft, A, and takes into the keyway therein. The starter is a tool which should be employed wherever engines are started by hand.

THE "EXCELSIOR" BATTERY.

A FORM of primary battery, under the name of the "Excelsior," upon which we make a few comments on page 281, has recently been introduced by Mr. F. Williams, of Clerkenwell. The battery consists of an outer cell of glass, earthenware, or ebonite, containing a porous pot in which is placed the specially amalgamated zinc element; in the outer cell is the carbon element packed around with a special depolariser, made as follows:

Bichromate of potash	3	parts.
Nitrate of soda	2	„
Permanganate of potash	2	„
Broken carbon	20	„
Black oxide of manganese ...	6	„
Chloro-chromic acid	4	„

This depolariser is made up in varied proportions, but the above briefly describes the essential components and their quantities. The chemicals are first slightly fused together, then well mixed with the carbon and manganese, and re-heated, and then a slow current of oxygen gas is passed through it for an hour or so, the resultant being a depolariser of high oxidation possessed, it is said, of a unique principle, viz., of self-oxidation or regeneration (when spent) by absorption of atmospheric oxygen from the ordinary air. The cell is loosely packed with this mixture, in which is the carbon plate. A piece of flexible rubber tubing is attached to the lower part of the porous cell, the use of which will be referred to. This cell is sealed up with the exception of two small gas holes. The zinc is specially amalgamated by being immersed and left in the following solution about an hour:

Nitrate of mercury	½ oz.
Hydrochloric acid	1 „
Water	1 pint.

By this method of treatment the zinc is said to become more thoroughly and heavily amalgamated than by the mere usual orthodox system of sulphuric acid and mercury amalgamation. To use the cell, a little mercury is placed at the bottom of the porous pot, and a solution of strong sulphuric acid excitant poured in. The cell is then allowed to stand for some little time, to allow the solution to percolate through into the sealed depolariser cell until a constant level is obtained (which should indicate in the porous pot three-quarters full), the zinc is then immersed, and the battery is ready for use. In a cell measuring 6 inches high, 4 inches diameter, with elements exposing each a sectional area of 17 inches, a current of 2 amperes at 1·785 volts E.M.F. is obtained, and by the large quantity of solid high oxidised depolariser the same is constantly obtained for 10—12 hours (large sets can be practically manufactured to go to 22—25). The cells will run much longer than this, but it is not practical to work them excessively, owing to a fall of current of from 4—5 per cent. When run down, however, at the end of this time, the battery can be recharged, by sending a current of air* through the depolariser (sealed cell) by means of the flexible tubing attached to the cell. In small batteries this may be done by the mouth or by a pair of household bellows, and in large sets by a special bellows supplied with the battery. The passage of the air through the spent depolariser reoxidises it, by the absorption of the atmospheric oxygen. The battery is guaranteed to run electric lamps at a price under ¼d. per 10-C.P. lamp hour, which price is guaranteed in all sets.

PORTABLE APPARATUS FOR RAPIDLY MEASURING INSULATION RESISTANCE.

THIS apparatus constructed by Ducretet and L'Lejeune, of Paris, and which is shown by the fig., comprises, in a very small compass, all the elements necessary for the rapid and exact measurement of insulation resistances in general.

The box containing the apparatus includes a galvanometer with shunts of $\frac{1}{2}$, $\frac{1}{10}$th, $\frac{1}{50}$th, $\frac{1}{100}$th, and $\frac{1}{1000}$th, and a plug switch enabling the current to be sent either through a fixed resistance of 10,000 ohms included in the apparatus or through the conductor being tested.

Another box accompanies the apparatus, containing 80 dry batteries, in series, with a potential difference at the terminals of about 100 volts; this is a convenient voltage and gives easily appreciable deflections of the galvanometer. The galvanometer magnet needle moves near the surface of a thick copper disc slightly hollowed to receive it, the object

* The inventor does not state for "how long."—EDS. ELEC. REV.

of the copper being to damp the deflection of the magnet due to the Foucault currents generated in the mass. If the magnet is twisted round 90° and let go, it comes to rest after 5 or 6 oscillations only.

The needle is fixed to a short axle, the lower point of which rests on a sapphire bearing, the upper point passing through a small ruby. An aluminium needle is fixed to the magnet and swings over a scale and a small mirror, placed under the needle, which facilitates the taking of the readings.

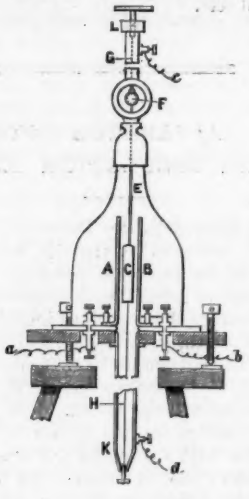
The scale of the galvanometer is graduated, experimentally, in such a manner that the ratio of two intensities of the current are given directly by the ratio of the corresponding readings.

The galvanometer normally is sufficiently delicate to enable an insulation resistance of 140 megohms—corresponding to a deflection of one division on the scale—to be measured. The sensibility of the instrument can be increased by bringing the controlling magnet, accompanying the apparatus, into use.

DUCRETET AND LEJEUNE MEASURING APPARATUS.

A NEW ELECTROMETER.

IN the *Annalen der Physik und Chemie*, xlviii, pp. 726—733, there is an account of a new electrometer by C. Christiansen. A section is shown in the accompanying figure. A and B are



condenser plates which are supported on a glass plate and are severally connecting to the copper wires, *a* and *b*. C is a compound or double plate, composed of zinc and carbon, and suspended between the condenser plates by means of the steel wire, E, which carries a mirror, F, and is itself suspended by means of the platinum wire, G, which is attached to the screw, L.

The zinc plate is in conductive connection with E, and the carbon plate with the wire, H, which is attached to the lower portion of the plate and ends in a screw at the bottom of the tube, K. Mica separates the zinc from the carbon. The bodies whose potential difference are to be measured are connected to the conducting wires, *c* and *d*, which are shown respectively in the upper and lower portions of the figure.

The plates, A and B, are about 12 cm. broad, 18 cm. high, and rounded at the top; their distance apart is 2·5 cms. The plates, C and D (D is immediately behind C and is not shown), are 1·7 cm. broad and 9·5 cm. high. The platinum wires are 2·03 mm. thick; G is 120 cm., and H 45 cm. in length. Therefore, $s = 1{\cdot}7 \times 9{\cdot}5 = 16$ cm., and $a = 2{\cdot}5$ cm.

The momentum of turning, M, is about $\frac{1}{2} V V_0$ in electrostatic measurement. If the potential difference of the condenser plates, A and B, be put equal to 100 volts, and that of the double plate C = to 1 volt, then the momentum sought for V or M becomes equal to $50/300^2 = 1/1{,}800$. It is obvious, therefore, that this is capable of producing a measurable twisting of the platinum wires.

In the formula $V V_0 = k^2(1 + \varepsilon V_0^2)\phi$, there are two constants. To determine the value of ε, the time, T, of oscillation of the double plate is observed; if the poles, *c* and *d*, are connected and the condenser charged with different potentials, then the time, T, is determined from the equation

$$T = 2\pi\sqrt{\frac{I}{1 + \varepsilon V_0^2}}$$

where I is a constant.

THE GREAT GERMAN SEARCH LIGHTS AT THE WORLD'S COLUMBIAN EXPOSITION.

AMONG the exhibits at the World's Columbian Exposition, which are prominent in the evening, are to be found the search light projectors, whose far-reaching arms of light tip different objects of interest in the grounds, with occasional flashes upon vessels, buildings, and other prominent objects many miles distant, illuminating them with all the splendour of sunlight, thus exhibiting in times of peace one of the most valuable implements of modern warfare.

Prominent among large search lights at the Fair may be seen the exhibit of Schückert & Co., of Nurnberg, comprising four of these monster search lights, placed on the four corners of the middle roof of the Manufactures building at a height of 240 feet above the ground. Owing to the failure of the electric department of the Fair to furnish

cables and current, only two of these lights are at present in operation. The top of the apparatus stands 8½ feet above the platform and the diameter of the projector is 5 feet. The mirror, which is of silvered glass, has a clear working diameter of 5 feet, with a thickness of about $\frac{7}{8}$ths of an inch. It is carefully ground and polished on both sides, the labour requiring over five months for its completion. The back of the mirror is provided with a heavy coat of silver, protected by a specially prepared paint. The training of the projector can be effected either by hand or by means of the electric motor placed under its base. When the electric motor is used it can be operated from any distance. The large projectors are intended especially for coast defence, and the apparatus for controlling the projectors must necessarily be near the commander.

It is said that the light from this projector can, under favourable conditions, be seen from Milwaukee, 85 miles distant, and a person standing eight miles away can read a newspaper illuminated by the light of the projector. A person standing at the side of the projector can, by the aid of a good field glass, distinguish the vessels of an enemy 20 miles away.

The peculiarity of this projector, aside from employing a parabolic mirror, consists in using an arc light having the carbons parallel with the axis of the projector, the positive carbon lying outermost, with the crater in the direction of the mirror.

The lamp used in the projector requires a current of 150 ampères at 50 volts, and consumes about 10 electrical H.P. The surface intensity of the light in this mirror is

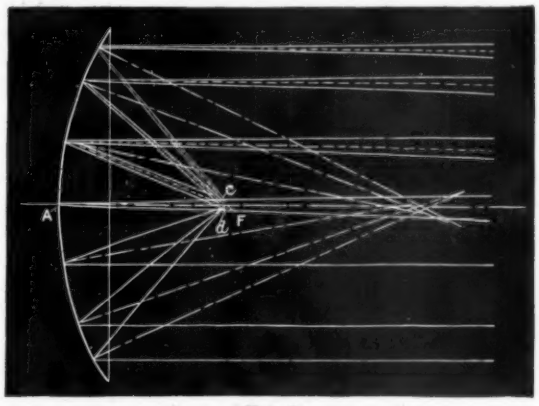


FIG. 2.

194,000,000 candle-power. The ends of the carbons are shown full size in fig. 1, and in fig. 2 the relation of the arc, F, to the mirror, A, is shown. The carbons may be adjusted to project either a convergent or a divergent beam, moving them inward toward the mirror producing the divergent beam, and moving them in the opposite direction producing the convergent beam. The average intensity of the rays received by the mirror is 45,600 candle-power, and the mirror takes up a beam having an angle of 140°. This angle includes the most intense rays, which lie between 40° and 60° from the normal.

The various points here given in relation to this interesting exhibit were furnished by Mr. Fred. W. Tischendoerfer, representative of Schuckert & Co., at the Chicago Exposition.

The artist correspondent of the *Scientific American* describes his adventures in witnessing the practical working of one of these great lights as follows: "In order to make my sketches it was necessary to do some climbing, owing to the new rule of not allowing the elevators to be run. I called around one evening about the time Mr. Tischendoerfer's assistant goes up, for him to show me the way. Going up two flights of stairs, walking a short distance through the gallery, we came to the foot of a ladder 42 feet in height. He started up, I followed close behind; at the top we crawled through a scuttle, walked along the eaves of the gallery roof about 200 feet, where we came to a second ladder, which was about 55 feet high. We climbed this, coming to the third ladder, which was about 125 feet. I have read of Jack and his bean stalk, it may be a nice story, but this was reality, as I climbed away, not daring to look behind me, one step after another, at last reaching the top of the long ladder. The last ladder to climb was 10 feet in height, bringing me on the cornice of the building, 240 feet from the ground.

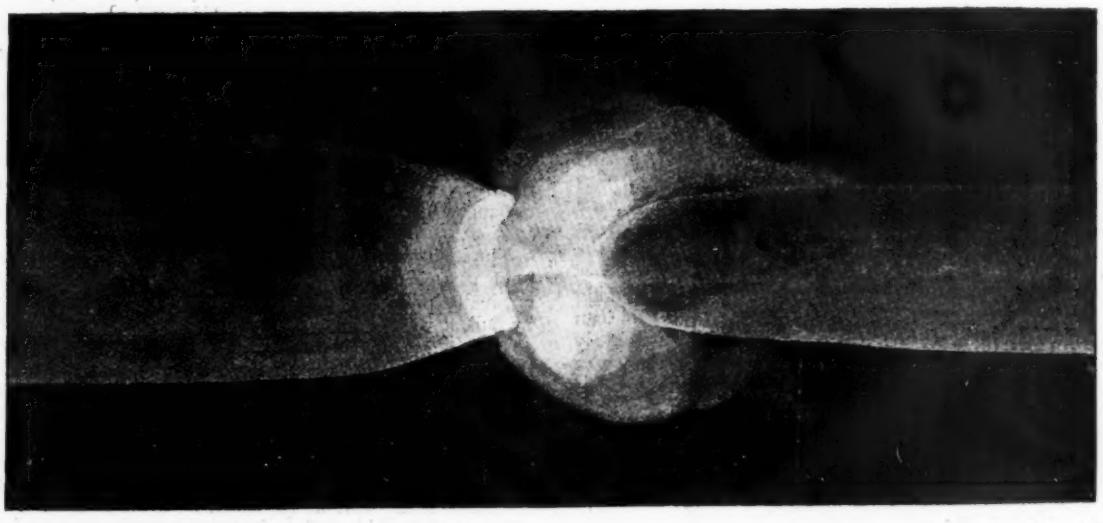


FIG. 1.

"The effect down below was beautiful. Thousands of electric lights glittering. The electric fountains throwing up purple, red, yellow, and green streams of water, which added to the scene. A storm was coming up in the distance, and I must say I felt lonesome upon that roof, a thousand feet in length. But I had come to see the search light and was very anxious to see it and get down as soon as possible. When the switch was thrown, the beam of light shot forth and the scene was more dreamy than ever. Gnats, flies, and thousands of vermin flying through the rays looked like bright pieces of metal. The power of the light being so great, when it was thrown on the Ferris Wheel, about two miles distant, the structure appeared to be like white enamel, although it is a dark object, the outline of which was very sharp and clear. Smaller details were distinctly seen. When the beam was thrown on a white object close by, the effect was surprising. It was like the focus of a sun-glass, and seemed as if the object must smoke in a few seconds.

Swinging the light on the battleship *Illinois*, it appeared brighter than when seen in full sunshine. The electric launches and gondolas looked like toothpicks floating around in the lagoons. People walking along the avenues looked about the size of small tacks. As it commenced to sprinkle, the light was shut off and covered up, and then the journey down commenced, with steady step by step, until I reached the ground in safety. It was a rare experience."

THE UTILISATION OF TOWN REFUSE FOR POWER PRODUCTION.

By THOMAS TOMLINSON, B.E., Assoc.M.Inst.C.E.

(*Continued from page* 274.)

THE experiment with midden refuse, described last week, was repeated in a trial extending from 9 a.m. on August 28th to 7 a.m. on August 31st, a total of 70 hours.

The sole changes made in the apparatus, as described and illustrated, were, providing an arrangement for turning over the charges in the retort, so as to liberate the steam and gas more quickly, increasing the size of the exhaust pipe from the retort, to enable it to carry off the increased quantity of steam and gas, and fixing a new cover with a small feeding door, instead of that shown in the illustration, since the charges were now considerably reduced in bulk and increased in number.

In working, the principal changes were two: (1) A fire was kept the whole time under the boiler, so as to keep the steam at 45 lbs. pressure. This was to compensate for the increased size of the exhaust pipe, and was found effective; no trouble was experienced with the fires during any part of the experiment, and consequently no fuel, other than that riddled from the treated refuse, was used. (2) Owing to the continual stirring and turning over of the mass, which was necessary, little time was left for riddling, and so the quarter sieve only was used throughout the trial to provide fuel, the resulting mass being put through the ¼th sieve after the trial was concluded; none of the breeze was therefore in this case used as fuel, and so a larger proportion of breeze and a less proportion of cinders was left over in this trial than in the last, consequently, although the balance-sheet given below shows a considerable increase in weight of fuel remaining over per ton of refuse, I doubt if an increase in its value can be fairly claimed, although such an increase is clearly indicated, and can be realised by so reducing the space between the bars as to admit of burning the breeze alone, which is of more importance, as you can depend upon large quantities of breeze owing to the wide spacing of the bars of household grates, but the amount of cinders depends upon the economy exercised.

The amount of refuse dealt with was 6 tons 17 cwt. 1 qr. 6 lbs., arrived at so :—

	Tons	cwt.	qrs.	lbs.
Amount over from last trial	3	0	0	0
Two loads, August 29th	2	0	0	0
Two loads, August 30th	2	4	2	0
	7	4	2	0
Weighed back (for purpose of another experiment)	0	7	0	22
Total dealt with	6	17	1	6

As a check upon the rate of destruction the refuse was measured in a wooden box specially made to hold one cubic yard, and the time at which the first charge was taken from each fresh cubic yard was noted in the log sheet. Of these measured cubic yards there were consumed during the trial 10·6, which gives for each cubic yard a weight of 12¾ cwt., a useful figure for newly collected midden stuff, though the quantity is too small to make it more than a useful approximation.

The resulting figures of the experiment, put into the same form as that before used, are :—

Refuse treated 549 qrs. in 70 hours, *i.e.*, at rate of 47 cwt. per 24 hours.

		Qrs.	P.C.
Fuel used		172	31
Fuel over	Cinders	40	25
	Breeze	92	
Dust		141	26
Pots, crockery, &c.		15	3
Clinker		36	6
Ashes		22	9
Water (difference)		31	

For purposes of comparison the result of the previous trial had better be repeated.

Refuse treated 310 qrs. in 65 hours, *i.e.*, at rate of 28½ cwt. per 24 hours.

	Qrs.	P.C.
Fuel used	115	37
Fuel over	53	17
Dust	66	21
Pots, Crockery, &c.	9	3
Clinkers	28	9
Ashes and water ... (by difference)	39	13

It will be seen that the percentages agree fairly well with each other, as near as can be expected from such varying material.

The gain in output per 24 hours is very marked, but the log shows a fact which illustrates the varying character of midden refuse and shows the absolute necessity for trials of long duration in dealing with such materials (if even moderately reliable results are to be obtained), the fact is this: During the first 48 hours 5 tons of refuse were dealt with, *i.e.*, at the rate of 50 cwt. per 24 hours, during the remaining 22 hours 1 ton 17 cwt. 1 qr. were treated, *i.e.*, at the rate of 40½ cwt. per 24 hours, a difference of 25 per cent. in the output caused by the extreme wetness of the last two tons delivered, which necessitated a reduction in the charges.

When the amount of fuel actually contained in the refuse treated is examined, the varying character of the material is further shown. The fuel in the first 3 tons 17 cwt. 2 qrs. (310 qrs.) amounted to 168 qrs., or 54 per cent.: no separate weights of the cinders and breeze consumed was kept, but in the residue the 53 qrs. consisted of cinders 22 qrs. and breeze 31 qrs. The fuel in the 5 tons (400 qrs.), treated in the first 48 hours of the second trial amounted to—

	Qrs.	P.C.	P.C.
Cinders	172	43	58
Breeze	60	15	

and in the 1 ton 17 cwt. 1 qr. treated during the remaining 22 hours amounted to—

	Qrs.	P.C.	P.C.
Cinders	40	27	49
Breeze	32	22	

It is not so much in the actual percentage of burnable material (though that varies nearly 20 per cent.) as in the varying proportions of cinders and breeze, that the difference consists.

The item "dust" in the balance sheets consists for the most part of carbon powder resulting from the excrement originally present in the refuse, and indicates its amount: by bulk it was 4 cubic yards. If a town had both a midden and a pail system (not an uncommon transition stage from the midden system towards the water carriage system), this dust being really animal charcoal, might be mixed with the pail contents to render these latter less noxious, and perhaps, also, from its known property of absorption of gases to make the manurial value greater. In fact it might very effectively take the place of the earth necessary to make the pail system tolerable (if it can be made tolerable). At any rate the ashbin refuse is reduced 60 per cent. in bulk, and the resulting product is harmless and may be tipped anywhere.

The experiment was begun and ended with the same precautions as before; the temperature in the flue between furnace and boiler varied between 700° F. and 1,000° F.; the consumption of water in the boiler was 3,700 lbs., or an average of 53 lbs. per hour, the steam blowing off slightly almost continuously, as the men found that their command of the furnace fire depended upon keeping up the pressure. Cold feed was used throughout, the pressure being designedly kept so low that the boiler could be fed direct from the mains.

I regret very much that I did not recognise the importance of estimating the contained water more accurately; it would only have been necessary to weigh each charge before and after treatment. The importance of this measurement arises from the fact that upon the amount of water, the amount and character (or calorific value) of the burnable material, and the amount and calorific value of the gases contained in any refuse treated, depends the power yielded outside the destructor, and also obviously the output per 24 hours; and it seems to me that records of destructor performances will be of little value to generalise on, until they are accompanied by some means of determining the calorific value of the material dealt with.

As a first approximation towards such a standard, let me suggest the following:

Consider ashbin refuse, and let

F be the total fuel (or fuel value) per ton.

f be the fuel (or fuel value) per ton outside the destructor.

W be the contained water per ton.

then $$f = a\,\text{F} - b\,\text{W} - c.$$

Where a, b and c are constants, depending upon the type and efficiency of the particular destructor for which we seek a formula, the manner in which the waste heat is utilised, and the way in which the destructor is worked. These constants could be determined from three experiments; but many more would be necessary before the average values of a, b and c could be relied on, and, of course, average values only could be expected.

If the refuse treated contained gas in appreciable quantities as compared to the actual contained fuel, as in midden refuse, or mixed stuff as ashbin refuse and sewage sludge, such as is now being treated at Ealing, and is about to be dealt with at Leyton, then the formula would become

$$f = a\,\text{F} \pm b\,\text{G} - c\,\text{W} - d,$$

where G represents the weight of gas-producing material per ton of refuse. In midden stuff this would be represented by the amount of animal charcoal remaining over, and in such mixtures of sewage sludge and ashbin refuse as at Ealing and Leyton, by the actual weight of sludge per ton of refuse. (The constant, b, might vary slightly according to the character of the town or district—purely residential or manufacturing.)

The alternative signs, before the b G in the above formula, indicates the alternatives of the contained gas giving heat to the furnace or abstracting it. A few simple experiments to be given later will show the general conditions governing this, *i.e.*, under what conditions respectively you will get burnable and unburnable gases from your refuse, assuming part of it to consist of excreta. In all probability the sign will be negative in all cases for an open destructor, because the amount of carbon dust present will fill the interstices of your material just as the fine material of unscreened coal would.

The measurement of F, f, G, and W, is easily effected with the retort destructor and its formula accordingly constructed, and with its assistance the formula can also be constructed for an ordinary destructor.

In the former case, all that is necessary is to weigh the charges before and after treatment, this gives W; weighing the fuel gives f and F, and weighing the carbon powder (or sludge), gives G.

For an ordinary destructor, we should have to proceed differently: First, suppose the material is ashbin refuse only. The material for a test—not less than 20 tons—should be thoroughly mixed and divided into two parts; one part should then be retort dried, the total fuel weighed, and the water estimated, by difference as before, giving the value of W. The fuel should then be burned under the boiler heated by the waste gases of the destructor (or a separate and similar one in case no independent means of firing is provided), this gives the evaporative value of F. The other part should then be consumed in the destructor and the boiler evaporation measured, this gives the evaporative value of f. Three such experiments would enable us to construct the formula for the particular destructor under trial, or rather for the particular arrangement of boilers and destructor, under trial; if we wished to eliminate the factor due to the boiler not being in the best position, then we should burn the fuel actually in the destructor and not under the boiler.

(To be continued.)

NEW PATENTS—1893.

16,168. "Improvements in arc electric lamps." W. J. DAVY. Dated August 28th.

16,175. "Improved method of fixing metal parts of electrical fittings to porcelain or other refractory substances." A. P. LUNDBERG. Dated August 28th.

16,197. "Improvements in electric traction apparatus." P. SCHOOP. Dated August 28th.

16,205. "A novel construction or arrangement of electrical resistance coil, and in appliances therewith for determining the amount of current passing through said coil." A. CHESTER and J. J. RATHBONE. Dated August 28th.

16,226. "Improvements in electric cars." E. EGGER, F. A. WESSEL, and A. NAUMBURG. Dated August 29th. (*Complete.*)

16,230. "An electric door mat for shop entrances and the like." W. B. RAMSEY. Dated August 29th.

16,265. "Improvements in electrodes for secondary voltaic batteries." G. PHILIPPART and G. LENTZ. Dated August 29th.

16,307. "Improvements in electric meters, dynamos, electrolysis of solutions, manufacture of sodium and sodium substitutes, manufacture of potassium cyanide, gold extraction, and recovery of tin from scrap." J. SWINBURNE. Dated August 30th.

16,342. "Improvements in conductors and arrangement thereof for distribution of electrical energy." G. WILKINSON. Dated August 30th.

16,389. "Improvements in electric heating apparatus." J. F. MCELROY. Dated August 31st. (*Complete.*)

16,480. "Improvements in or connected with electrically propelled boats." K. D. BOWEN. Dated September 1st.

16,483. "Improvements in and relating to electric switches." H. C. CHOCQUEEL. Dated September 1st.

16,484. "Improvements in self-starting alternating current electromotors." H. H. LAKE. (Communicated by F. H. Sleeper, Canada.) Dated September 1st.

16,514. "Improvements in incandescent electric lamps." E. C. LACEY and W. HARGOOD. Dated September 2nd.

16,562. "Improvements in electric motors." B. WILLCOX. (Communicated by E. R. Esmond, United States.) Dated September 2nd. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

491. "Improvements in and relating to underground conduits for electric wires." C. A. W. HULTMAN. Dated January 9th. Claims:—1. As a means for strengthening and holding in place cement or other blocks employed as conduits for underground electric cables or wires, metallic bars or tubes combined with such blocks, and lodged in exterior longitudinal grooves therein, larger in cross section than such bar or tube, and secured therein by a suitable cementing material, all substantially as set forth. 2. Blocks for underground electric cables or wires, having their ends reduced and bevelled as set forth, and having the adjacent ends of such blocks wrapped with hempen or other cloth, prepared with asphaltum as described, and some of the said joints then filled with a suitable cement, and others with asphaltum or suitable flexible material.

568. "Improvements in electric incandescent lamps." G. BAMBERG. Dated January 12th. The inventor prevents combustion in air by coating that part of the filament of carbon which is to be rendered incandescent with such suitable incombustible and coherent material or materials, which shall not be liable to fuse at the temperature of the incandescent carbon or other suitable filament. The incombustible coating can be made from mixtures of the oxides of the metals of the earths, and alkaline earths and gypsum with silica and silicates, in such suitable proportions that will secure, as far as possible, a coating that will expand and contract equally with the internal carbon filament. 2 claims.

1,459. "Apparatus for adjusting commutators of dynamo-electric machines and motors to varying speed." W. WHITE, J. RADCLIFFE and F. W. COOKE. Dated January 25th. According to the present invention the brushes are arranged to be stationary, while the commutator is turned more or less round upon the armature shaft to suit variation of speed. For this purpose, within the driving pulley of the machine, two weights are fitted to slide radially outwards, in opposition to springs, these taking the place of the balls of a centrifugal governor, sliding farther out the greater the speed with which the pulley rotates. Each of these weights bears against one end of a lever mounted on the pulley, and suitably guided, the other end of which lever is engaged in a cam groove formed in the face of a disc attached to the commutator. The ends of the levers are moved more or less towards the centre of the disc, according as the governor weights are moved more or less outwards by the centrifugul force due to the speed of the pulley, and these lever ends acting on the curved edges of the cam grooves, shift the disc and commutator more or less backwards relatively to the armature coils. 1 claim.

1,464. "Improvements in holders or sockets for incandescent electric lamps." T. JENNER. Dated January 25th. The body of the holder is a tube of insulating fibre or other non-inflammable insulating material. The covered leads or wires enter the one end of the tube through a screwed brass nipple forming the bottom of the tube, and connect to screws which are screwed into the tube from the outside. 4 claims.

1,552. "Improvements in telephone transmitters." J. GOFFIN. Dated January 26th. Consists in arranging an intermediary diaphragm taking, instead of a single point of contact at the centre, any suitable number of points of contact upon the said circle of the diaphragm. 2 claims.

1,637. "Improvements in and connected with telephones." G. L. ANDERS and W. KOTTGEN. Dated January 27th. The transmitter has preferably a cylindrical base provided with a recess in which is placed a microphone enclosed by a diaphragm surmounted and held in place by an annular ring which serves the double purpose of a mouthpiece and a receptacle for the receiver. The terminals for the

line, battery, earth and bell are suitably attached to the transmitter base, while conducting cords from the battery and line terminals on the microphone connect the transmitter with the receiver. Battery and circuit is rendered unnecessary. The mouthpiece of the receiver for listening and the case is formed in one piece, and at the back of the case is a screw thread fitting on a screwed collar, said collar clamping all the parts firmly. 5 claims.

1,786. "Improvements in or relating to tanning by electricity." R. PINNA. Dated January 29th. Consists in causing weak alternate currents, with a slight difference of potential, to pass through the hides or skins steeped in the tanning bath, however it may be prepared. 1 claim.

1,878. "Improvements in means or apparatus for protecting underground electrical conductors." F. DAVIS and R. E. B. CROMPTON. Dated February 1st. Consists in substituting for the pipes or groups or bundles of pipes or other channels of iron or other material into which or through which electric conductors are laid or drawn, cellular cases, preferably made of cast-iron, divided longitudinally into triangular, square or polygonal passages, preferably hexagonal, arranged in such a manner that the whole cellular casing forms a casting of great lightness and strength, capable of resisting severe lateral strains, and of such construction as to ensure sound casting. 2 claims.

2,163. "Improvements in electric measuring apparatus." R. E. B. CROMPTON. Dated February 4th. An improved form of potentiometer consists in a framework of any desired length which may be made of carefully seasoned wood so built up or connected together that it maintains itself without distortion of form through very considerable changes of temperature or of moisture in the atmosphere. Instead of stretching or mounting the whole of the slide wire in the manner usual in this kind of apparatus either over or on one side of the framework carrying the corresponding scale the inventor only mounts one fractional part of it in this manner, that is to say if he chooses to employ a slide wire 10 metres in length and having a resistance of 100 ohms, 1 metre of it only is applied to the measuring scale which for convenience may be divided into 1,000 parts, and the remaining 9 metres is stretched alongside the first portion which is over its scale by being wound alternately round certain insulating pulleys placed at each end of and adjacent to the scale. In order to provide fixed contacts on this wire at the desired points, viz., at one point at the commencement of the scale and at nine other points on the remainder of the wire he provides 10 knife edge contacts over which the wire passes and against which it presses. 3 claims.

2,198. "Improvements in culverts for electric mains." F. THORNTON and LATIMER CLARK, MUIRHEAD & Co., LIMITED. Dated February 4th. The inventors make culverts to receive not only the uninsulated mains but also insulated cables. For this purpose they make on the underside of the bridge pieces two or more semi-circular notches, and in the bottom of the trough they make two or more semi-circular and corresponding grooves. When the culvert is laid wires are placed in these grooves, which serve to draw in the cables, the bridge pieces forming guides to keep the wires and cables in the grooves. They also form a continous drain along the underside of the culvert. 4 claims.

2,393. "Improved method of and appliances for using electricity as a medicinal agent." W. GRIGG. Dated February 8th. Consists firstly, in various appliances for conveying an electric current for medicinal purposes to any part of a human or animal body, under various conditions, and, secondly, an electro-magnetic generator and regulator, which may be used with the appliances before referred to, or these may be used in combination with any other form of generator or source of electricity. 4 claims.

2,690. "Improvements in electric arc lamps." H. TIPPING. Dated February 11th. Claims:—1. The arrangement or combination and use of parts of an electric arc lamp so that the feed of the carbons is controlled by means of rack and wheel work, or equivalent mechanism, regulated as to the recurrence of the feed by means of an inclined surface and pivot co-operating therewith or equivalent device, to effect disengagement of the armature and parts actuated by it, substantially as and for the purpose set forth. 2. In an electric arc lamp the arrangement of parts for supporting and controlling the movement of the carbons in combination with means for regulating the recurrence of the feed as and for the purpose set forth.

13,989. "Improvement in telephony." J. W. GIBBONEY and ELIHU THOMSON. Dated August 2nd. Consists, briefly, in putting on the line a set of pulsations or alternations of current from a suitable source which are made to pass through the turns of a coil in inductive relation, as in transformers or induction coils, to another coil or coils, the current in which latter coil or coils is made to vary by a change in inductive capacity or change of resistance or self-induction, or changes of these effects jointly, to a greater or less extent brought about by the vibrations of the voice as in speech transmission, or other mechanical impulses imparted to the transmitter or diaphragm provided therefor. 23 claims.

14,785. "Improvements in and relating to electric despatch systems, and carriers therefor." A. BRYSON. Dated August 16th. The object of the invention is to provide a carrier for despatch systems having its own electrically-propelled motor, and adapted to have its direction controlled from the start, whereby it will automatically be switched off and the circuit broken or maintained, as the case may be, at any predetermined station or branch. 4 claims.

15,999. "Improvements in the manufacture of electrical circuits and cables." A. V. NEWTON. (Communicated from abroad by J. A. Barrett, of New York.) Dated September 6th. The inventor weaves the conductors so as to form a circuit which is practically a flat band, and so that the insulating material between the conductors may be increased without increasing that outside the same. 20 claims.

16,794. "Improvements in signal telegraphy." C. V. BOUGHTON. Dated September 20th. Consists of a series of incandescent lights preferably arranged upon a horizontal line, each light being connected by wire to a separate post, and each post being connected to a second post, a keyboard having separate keys for each figure or character to be employed, and each key having connecting pins for closing the circuit with a particular combination of wires leading to different second posts, and through which the circuit passes, illuminating the combination of lamps assigned to the character. 2 claims.

17,169. "Improvements in or relating to the electrolytical decomposition of metallic salts, and in apparatus therefor." C. KELLNER. Dated September 26th. Relates to the use in the electrolytic decomposition of metallic salts, of a mercury cathode of novel construction for the purpose of obtaining metals in the solid or metallic state, or in the form of hydrates, or other desired combinations of the same. It also relates to apparatus whereby the use of mercury for this purpose is rendered practicable for operations on an industrial scale. 15 claims.

17,224. "Improvements in apparatus for electrically heating and working metal." W. P. THOMPSON. (A communication by C. L. COFFIN, of America.) Dated September 27th. Consists in an apparatus particularly adapted for forming heads on bolts, or machine screws, and work of that kind. 5 claims.

17,225. "Improvements in the method of and apparatus for electrically welding metals." W. P. THOMPSON. (A communication by C. L. Coffin, of America.) Dated September 27th. Claims:—1. The described method of welding or working metals electrically, consisting in heating the metal by passing an electric current therethrough, upsetting each of said articles an appreciable distance back from the point of welding, and not at the plane of junction, then bringing said articles in contact and passing a heating current therethrough, and then pressing the two articles to be welded together. 2. The described method of welding metals electrically, consisting in first heating the articles to be welded by passing an electric current therethrough, then upsetting each of said articles an appreciable distance back of the place of welding and not at the plane of junction, then pressing said articles together to form a weld, finally completing the weld by swaging, hammering, &c. 3. The improved apparatus for electrically welding metal, combined and arranged substantially as described.

17,304. "Improvements in electric heaters." T. AHEARN. Dated September 28th. An electric current heats a coil, which is insulated from metallic casings by asbestos and mica (or asbestos alone) on one side and a powdered material on the other, while the latter conducts the heat generated to the encasing tubes, or principally to one or other of them if so desired, whence it is taken up by the current of air by radiation. 4 claims.

17,321. "Improvements in electric water heaters." T. AHEARN. Dated September 28th. Consists of an open vessel, preferably metallic and a good conductor of heat. Upon this are placed strips of insulating material, such as asbestos. Upon this insulation is wound a coil of wire or strip of refractory material having a high electric resistance, such as German silver, and the terminals connected with leads of an electric circuit. The vessel thus insulated, coiled and connected, is placed in a larger vessel or container, large enough to leave an annular space all round the inner vessel, and also a space between the two bottoms. The latter space is packed with a good non-conductor of heat and electricity, such as asbestos, and the annular space is filled with powdered whiting, fire-clay, or other refractory material, which is also a non-conductor of electricity. 2 claims.

17,563. "An improved detachable electric lamp jointing for removable lamps for shop fronts and similar situations." W. R. WYNNE. Dated October 3rd. Has for its object a detachable jointing which shall be sufficiently rigid to prevent any such breakage of the electrical contacts, and at the same time admit of easy disconnection when such is required. 2 claims.

17,647. "Improvements in galvanic curative appliances." H. HYLTON-FOSTER. Dated October 4th. Consists in making a garment, or such portions of a garment as it is desired shall possess the remedial properties, of a chain mail form, making such chain mail in rings or links of zinc and copper. 1 claim.

17,743. "Improvements in arc electric lamps." E. DE PASS. (Communicated from abroad by L. Bardon, of France.) Dated October 5th. Claims:—1. The construction of differential regulators for arc lamps, substantially as described. 2. In regulators for arc lamps, the construction of the cheek of the upper face of the bobbin of iron, and the combination therewith of two lateral bars of soft iron, for the purpose set forth. 3. The arrangement of slides above described, for permitting the carbons to be changed without the necessity of detaching the globe, substantially as described.

17,774. "Improvements in dynamo-electric machines, and in their application to secondary battery installations." E. W. COWAN and W. P. J. FAWCUS. Dated October 6th. Claims:—1. The construction of a dynamo-electric machine, substantially in the manner described and shown on the drawing, capable of supplying simultaneously an alternating and a continuous current of electricity at different mean electromotive forces relatively adjustable within the limits described. 2. The application of the improved dynamo, described to the charging of secondary cells and lighting of lamps simultaneously.

18,116. "Improvements in and relating to electric arc lamps." W. MATHIESEN. Dated October 11th. Relates more especially to that class of lamp furnished with only one electro-magnet which is included in a shunt circuit and effects the striking and subsequent regulation of the arc. 5 claims.

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